GW Research SHOWCASE
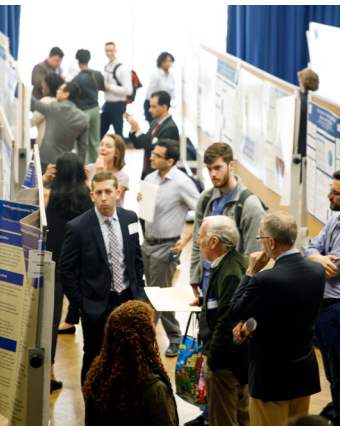
2020 ABSTRACT SUBMISSIONS

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

TABLE OF CONTENTS

ACKNOWLEDGMENT

GW Research Showcase 2020 was scheduled to be held on Tuesday, April 7th, 2020. Organizers made the difficult decision to cancel the event in light of the rapidly changing circumstances surrounding the COVID-19 pandemic. It marked the first time this annual celebration had been canceled in more than 20 years.

The organizers wish to acknowledge the hard work and research accomplishments of GW's students and research mentors by publishing this digital booklet containing all of the abstracts that were received. The submissions exemplify the high-impact research, scholarship and creativity that is being conducted at GW.

GW Research Showcase would not be possible without the support of numerous partners. A special acknowledgement is due to co-organizers from the **Center for Undergraduate Fellowships and Research** and **GW Libraries and Academic Innovation**.

Additionally, the following collaborators provided key support or planned an exhibit at the event:

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- Clinical and Translational Science Institute at Children's National
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Basic Biomedical Sciences

Children's National Medical Center

PRIMARY PRESENTER

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RESEARCH MENTOR/DEPARTMENT CHAIR

Michael Hsieh

ABSTRACT

H-IPSE, a Pathogen-Secreted Host Nucleus-Infiltrating Protein (Infiltrin), is Mainly Internalized through Clathrin-Mediated Mechanisms by a Specific Range of Target Cells

IPSE (IL-4 Inducing Principle from Schistosoma mansoni Eggs) is one of the most abundant egg secreted proteins of the Schistosoma parasite. IPSE in an immunomodulatory protein that interacts with IgE on the surface of basophils to induce IL-4 secretion, triggers Breg cell activation, and, as an infiltrin, translocates into host cell nuclei to alter host transcription. Given these functions, IPSE is a candidate therapeutic for inflammatory disorders. IPSE binds to DC-SIGN and the mannose receptor, suggesting it may have specific cellular receptors. Our objective was to characterize which cell types internalize H-IPSE (the Schistosoma haematobium ortholog of IPSE) and determine if this occurs by clathrin- and/or caveolin-mediated endocytosis. H-IPSE variants H03 and H06 were conjugated to Alexa-488 fluorophore and flow cytometry was used to quantify internalization. H03 was incubated with urothelial, endothelial, immature dendritic, hepatocyte, and neuronal cell lines for 24hrs. The percentage of cells positive for intracellular H03 was 78, 28, 38, 40, and 7 percent, respectively. Urothelial cells were pre-treated with filipin (inhibiting caveolin-mediated endocytosis) and/or chlorpromazine (inhibiting clathrin-mediated endocytosis) before treatment with H03 or H06. When cells were pre-treated with chlorpromazine, the proportion of cells positive for IPSE was similar to that of untreated cells, suggesting IPSE utilizes mainly clathrin-dependent mechanisms. H-IPSE's minimal internalization by hepatocytes suggests that IPSE may not be hepatotoxic or contradictory to previous findings. Our unpublished data showing that IPSE alleviates capsaicin receptor-mediated pain, led us to postulate that IPSE acts through the capsaicin receptor on nociceptive neurons. However, our findings indicate that IPSE is inefficiently taken up by neurons and may be inducing neuronal effects despite inefficient uptake, or through an alternative pathway. Additional research is underway on IPSE's endosomal escape mechanisms and activity within host cell nuclei to provide further insights into its role in the pathogenesis of schistosomiasis and therapeutic potential.

Basic Biomedical Sciences

Institute for Biomedical Sciences (PhD Students in IBS Only)

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RESEARCH MENTOR/DEPARTMENT CHAIR

Edward Seto

ABSTRACT

Regulation of HDAC1 through an EGFR-Related Mechanism

Histone deacetylase enzymes (HDACs) catalyze the removal of acetylation from their substrates. Through their modification of histones and non-histone proteins, HDACs can influence gene transcription and various cellular processes, which affects normal physiological processes, as well as disease development and progression. Importantly, HDACs themselves can be regulated by post-translational modifications (PTMs). In this study, we explored the possibility of the modification of the histone deacetylase HDAC1 by tyrosine (Tyr) phosphorylation, which has been detected in various mass spectrometry studies referenced in publicly-available databases but has never been validated. We found that HDAC1 is modified by tyrosine phosphorylation in non-small cell lung cancer (NSCLC) cells and that its phosphorylation is reduced upon treatment of the NSCLC cell line PC-9 with the epidermal growth factor receptor (EGFR) tyrosine kinase inhibitor (TKI) gefitinib. Additionally, gefitinib treatment of PC-9 cells was associated with reduced HDAC1 expression, suggesting that tyrosine phosphorylation may be important for its protein stability. Evaluation of one predicted phosphorylation site, Tyr72, by the generation of the loss-of-phosphorylation tyrosine-to-phenylalanine mutation showed that this residue is also important for HDAC1 expression. Additionally, the loss-of-phosphorylation mutation at Tyr72 affects the role of HDAC1 in cell cycle progression and apoptosis. This research provides greater clarification regarding the mechanisms by which HDAC1 may be regulated, particularly in the disease context of NSCLC. Given that EGFR and HDAC1 are considered targets, both individually and in combination, for the treatment of cancer, this research provides insight into a relationship between the two proteins that could be further studied to develop new therapeutic approaches for NSCLC.

Basic Biomedical Sciences

Institute for Biomedical Sciences (PhD Students in IBS Only)

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ABSTRACT

Differences in the Platelet mRNA Splicing Landscape Affect Platelet Activation and May Contribute to Racial Disparities in Cardiovascular Disease

Cardiovascular disease (CVD) is the leading cause of death, both in the U.S. and worldwide. Aberrant platelet activity has been linked to an increased risk of CVD, including thrombosis, arteriosclerosis, stroke, heart attack, and pulmonary embolism. African Americans are 1.2 times more likely to develop CVD and have higher morbidity and mortality rates. Racial differences in platelet activity have been linked to polymorphisms in platelet-related genes and differential gene expression, but little research has investigated the role of differential alternative RNA splicing on platelet activity.

Platelet RNA-Seq data from public repositories (i.e. Gene Expression Omnibus, N = 55) and a cohort of healthy volunteers (N = 23 of European (EA) and N=21 African American (AA)) were analyzed to catalog mRNA splicing events. Analysis of public RNA-Seq data identified 7,293 expressed genes (average of 5 mRNA splice variants/gene). Atypical RNA splicing events were found in genes known to participate in platelet activation (i.e. ARRB1, SNAP23). Uncommon splicing events involving druggable targets were uncovered, including ITGB3 (targeted by abciximab), TBXAS1 (targeted by picotamide), and GP6 (targeted by ACT017). Investigations into two splice variants of GP6 revealed differences in phospohylation of proteins known to be involved in platelet activation upon GP6 activation with collagen. Further investigations are being completed to determine the functional consequences these differences have on platelet activity.

In a comparison between EA and AA platelet samples, 1,187 genes were identified as differentially spliced, including genes participating in platelet aggregation (e.g. CAST) and RNA processing (e.g. DROSHA, DICER). These unique splicing events portend protein isoforms leading to differential platelet activity. The functional consequences of these novel splicing events are currently under investigation.

This study reveals that the mRNA splicing landscape diverges at the population level (AA compared to EA individuals), and these differences may affect platelet function and serve as biomarkers to identify CVD risk, novel druggable targets, and therapeutic outcome for anti-platelet drugs.

Basic Biomedical Sciences

Institute for Biomedical Sciences (PhD Students in IBS Only)

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ABSTRACT

Pesky Pipelines and Microbiome Studies: Improving Accuracy and Finding Consensus Across Whole Shotgun Metagenomics Pipelines

The young field of metagenomics, unlike other fields such as microarray-based transcriptomics, has failed to converge towards standard analytical methods. As a consequence, successful curation of metagenomic data is an especially pressing challenge. Taxonomic profiling is a common goal of metagenomic studies that is plagued by a lack of standardized methods. In taxonomic profiling studies, researchers analyze the genetic material of a sample to determine the taxonomic diversity of its microbial community. Whole shotgun metagenomics (WSM) has emerged as a possible remedy for some of the biases introduced by older, 16S-based methods, but it remains the case for both 16S and WSM-based techniques that various steps in a computational analysis of microbiome data can introduce errors or differences in the final results. Small, computational, pipeline-specific differences can bias conclusions, estimate taxonomic profiles inaccurately, and corrupt curation efforts. Recent research has highlighted that although most bioinformatic pipelines for microbiota studies report the same trends, each pipeline generates unique results that can affect the biological conclusions which can be drawn. In their current state, computational metagenomic pipelines also frequently misclassify taxa in the human gut, necessitating a manual curation step by seasoned experts to eliminate incorrect assignments. As long as taxonomic profiling results continue to be pipeline-specific and expert-dependent, the efforts of the field to accurately curate metagenomic databases will be hindered. More precise taxonomic profiling leads to a more accurate and confident assessment of the role of microbiota in disease which, in turn, leads to a better ability to curate databases with reliable information.

This poster outlines the status of our efforts to evaluate and improve the accuracy of taxonomic profiling and curation using computational WSM analysis pipelines. As part of this research, we are developing a tool which directly assists curation efforts by 1) correcting taxonomic classifications that erroneously correspond to bacteria not found in the human gut and 2) retroactively correcting the output of a WSM pipeline based on its unique handling of in-silico WSM reads. By doing so we hope to bolster efforts to improve the accuracy of curation and to work on converging disparate approaches in the field towards standard practices.

Basic Biomedical Sciences

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ABSTRACT

Investigation of HDAC-Mediated Acetylation of SOX10

Melanoma is the most fatal form of skin cancer, associated with an estimated 9,000 deaths in the US annually. It is a highly resilient cancer, with no effective therapy when the tumor progresses into metastasis, thereby spreading to different organs. Microphthalmia-associated transcription factor (MITF) controls the expression of genes that are essential for normal melanin synthesis in melanocytes as well as the progression to malignant melanoma cells. MITF itself is regulated by four main transcription factors, which each have a binding site in the MITF promoter: CREB, SOX10, LEF1, and PAX3. The four transcription factors that regulate MITF may also be regulated by protein modifications. Post-translational modifications, such as acetylation, play an important role in regulating the function and subcellular localization of proteins. Protein acetylation is a reversible process that is tightly regulated by histone acetyltransferases and histone deacetylases (HDACs), which catalyze the addition and removal of acetyl groups from their substrates, respectively. Several mass spectrometry experiments have detected that SOX10 is post-translationally modified by acetylation, but this has yet to be confirmed. Further, the significance of the SOX10 modification is entirely unknown. Preliminary data suggests that HDAC8 inhibition reduces the protein levels of MITF. The objective of this study is to test whether HDAC8 regulates MITF protein expression via a change in SOX10 acetylation. In 293FT cells, we detected the post-translational modification of SOX10 by lysine acetylation. Furthermore, we detected changes in SOX10 protein acetylation upon treatment with different HDAC inhibitors. Further research will be conducted to assess the possibility of an interaction between SOX10 and HDAC8, as well as several other HDACs that may affect SOX10 protein acetylation. This research seeks to clarify the underlying mechanism by which HDACs may regulate gene expression (or other cellular functions) in melanoma. Further research has the potential to provide the basis for novel therapies for malignant melanoma.

Basic Biomedical Sciences

School of Medicine and Health Sciences

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ABSTRACT

Gene-Gene Interactions in Salt-Sensitive Hypertension: The Role of Micrornas and Epigenetic Dysregulation

Salt sensitivity is a complex condition that has significant implication in the regulation of blood pressure. The etiopathogenesis underlying impaired renal NaCl handling and consequent effect on long-term regulation of BP remains unclear. However, increasing evidence suggests that aberrations of transcriptional mechanisms, including microRNAs (miRNAs,miRs) play an important role. Here, we assessed microRNA expression levels in human renal proximal tubule cells (hRPTCs) carrying genetic variants in two electrolyte homeostasis genes, G protein-coupled receptor kinase type 4 (GRK4 rs2960306) and SLC4A5 (rs7571842 and rs10177833). We also interrogated gene expression of selected miR targets. Recent preliminary experiments identified differential expression in microRNA-19 and miRNA-32 in hRTPCs carrying SLC4A5 variants. We sought to reveal effects of single nucleotide polymorphism (SNP) interactions between GRK4/SLC4A5 variants. miRNA microarray was performed in three distinct SNP containing hRPTC lines. miR-19 and miR-32 expression levels as well as pathway analyses were rendered in conjunction with predicted target gene mRNA expression levels via RT-qPCR. Among the 3 examined cell lines, the GRK4/SLC4A5 homozygous SNP cells showed decreased miR-19 and miR-32 expression levels compared with two-fold increased expression in GRK4 variant, SLC4A5 normal genotype. Also, our findings showed deregulation of predicted target genes, SLC9A, SLC26A6, NHE1, ATP1B1, suggesting aberrant microRNA expression in hRPTCs carrying SLC4A5 SNPs in the presence of GRK4A5 SNPs. Together, our results demonstrate that salt-sensitivity implicated in the regulation of blood pressure is likely associated with miRNA dysregulation due to SNP-SNP interactions, suggesting that strategic targeting could be a promising therapeutic mechanism in treatment of salt sensitivity.

Basic Biomedical Sciences

School of Medicine and Health Sciences

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Tatiana Efimova

ABSTRACT

Targeting p38 Isoforms to Inhibit Growth and Invasion, and to Overcome Therapy Resistance in Human Malignant Squamous Cell Carcinoma

Squamous cell carcinoma (SCC) is one of the leading causes of death with its incidence continuously rising each year. Current treatment modalities are not satisfactory due to their associated toxicities and resistance that hinder a good prognosis. The aim of this study was to delve into more efficacious therapies using a molecular approach in hopes that a superior treatment can eventually be extended to patients in clinic. We investigated the role of the stress-activated protein kinases, p38α and p38δ, as potential targets for treating human skin and head and neck SCC. Our preliminary data showed that a simultaneous targeting of p38α/p38δ significantly blocks proliferation, survival, and invasion in human SCC lines. Using pharmacologic and genetic approaches, we aim to: investigate the mechanisms underlying these effects in the SCC cells, determine whether p38α/p38δ inhibition modulates the responses of SCC cells to common therapies, and to elucidate the mechanisms involved. Western blots using murine oral cancer1 (MOC1) cell lysates were run to examine whether the expression of the proteins p-NFkB and p-ERK1/2 changed between treatments with control, a p38α/p38β inhibitor (SB), and a potent pan-p38 inhibitor (C62) at 24 hours, 48 hours, and 7 days. Phosphorylated (active) ERK was most upregulated in C62-treated samples for all timepoints, which was not seen for SB at any time point, while C62 downregulated p-NFkB (active) compared to control and SB at 48 hours. Using SCC12 cell viability assays, we investigated the effects of p38α and p38δ pharmacologic inhibition or genetic knockdown both individually and simultaneously, in response to treatments with EGFR-inhibitor AG-1478 (AG) or Cisplatin. We found that p38 α /p38δ co-inhibition using 2 M C62 + AG was synergistically cytotoxic in SCC12 cells while the combination treatments with SB and AG led to a decreased viability. SiRNA-mediated knockdown (KD) of p38δ, but not p38α, augmented AG-induced cytotoxicity, compared with AG treatment alone (50 M). Notably, a combined p38α/p38δ KD also resulted in a synergistic decrease in cell viability at 50 µM AG. For the cisplatin treatment, only SiRNA-mediated p38δ KD and p38α/p38δ KD affected cisplatin-induced cells with a synergistic decrease in cell viability at 10 and/or 25 µM cisplatin, compared with cisplatin treatment alone. The cell viability assays should be repeated to further corroborate the results. Investigation of p38 expression between sexes is also necessary to make sure that this potential therapeutic target is equally efficacious for both males and females.

Basic Biomedical Sciences

School of Medicine and Health Sciences

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ABSTRACT

Encouraging Interest in STEM via an Innovative Summer Program

There are an estimated "7 – 10 billion laboratory tests performed each year in the United States," and at least 70% of all medical decisions are made through the use of laboratory test results. This past year, the Laboratory Science profession was rated as one of the top one hundred jobs in healthcare by US News & World Report. Despite this, there is currently a shortage in the laboratory workforce that is only expected to widen in coming years. The Bureau of Labor Statistics estimates that the need for trained laboratory professionals will increase 11% from 2018 to 2028, much faster than the average occupation.

Consequently, we developed an innovative summer program aimed at exposing STEM-oriented high school students to laboratory science, diagnostic medicine, and other health professions. This program, held in one-week sessions, included 6 hours of daily hands-on, interactive activities along with relevant instruction and development of foundational knowledge.

To quantify program success, a pre-test and post-test was implemented. Students (N=274; 196 Female, 78 Male) achieved significantly ($p > 0.001$) higher scores on the post-test compared to the pre-test, indicating that they learned key information during the program. Additionally, an exit survey was provided to gauge student sentiment; 84% of students felt that the program stimulated their interest in laboratory medicine, and 95% felt that they were more knowledgeable about health science then they were before. The program, now in its fourth year, has successfully introduced laboratory medicine and broader aspects of health care to the local population of future health care professionals, igniting interest, and affording us an opportunity to provide outreach to the local community.

Basic Biomedical Sciences

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

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ABSTRACT

Designing a Nanotherapeutic Device for Treatment of Advanced Glioblastoma Multiforme

With a persistent 5% 5-year survival rate, the need for novel therapeutic strategies to treat Glioblastoma Multiforme (GBM; a stage IV brain cancer) remains great. Nanomaterials, particularly Prussian Blue Nanoparticles (PBNPs), present a unique means to achieve cancer cell death through both localized hyperthermia and sensitization of cancer cells to subsequent cell-based immunotherapies. In this work we present "aFn14-PBNP": a novel nano-bioconjugate against GBM with the ability to not only induce immunogenic cell death (ICD), but also reduce the cancer cell's invasiveness and sensitize the cancer cell to subsequent immunotherapies. PBNPs were synthesized via a pre-existing nanoprecipitation protocol. The surface of these particles was then covalently decorated with fluorescent GBM-specific targeting moieties (an antibody against aFn14). Photothermal Therapy was performed on a population of U87 GBM cells by combining bioconjugated PBNPs with near-infrared LASER energy. ICD, as measured by flow cytometry, was successfully achieved in upwards of 84% of the cell population. Moreover, the remaining cell population that did not undergo cell death as a result of direct thermal injury was found to have upregulated T-cell costimulatory markers, downregulated invasive markers, and upregulated TSAs that are targetable by subsequent cell-based immunotherapeutic adjuncts (i.e. CAR T-Cells). Through further exploration of this combinatorial nanoimmunotherapeutic treatment modality, it is the hope that strides are made in reducing the dismal mortality rate of this fatal cancer.

Biomedical Engineering

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ABSTRACT

Fluorescence Recovery After Photobleaching to Assess the Cardiotoxicity of Medical Device Plasticizers

The prevalence of plastic chemicals in accordance with medical manufacturing equipment has raised growing concern over patient exposure to plastic chemicals (PCs = phthalates and bisphenols). Di-(2-ethylhexyl) phthalate (DEHP) is a main component of polyvinylchloride plastics used in many medical devices. DEHP can leach into blood or other lipophilic solutions, where it is hydrolyzed to mono-(2-ethylhexyl) phthalate (MEHP). Pediatric ICU patients can have DEHP exposure >1,000 fold higher than deemed safe by regulatory agencies. Studies suggest that the adverse effects of DEHP-exposure may be attributed to its intercalation into cell membranes, and subsequent disruption of intercellular communication. Due to the increased exposure to plasticizers employed in revolutionizing medical care, there is a growing concern for direct and indirect PC exposure on human health, especially in vulnerable populations.

The objective of this study was to quantify the toxicological effects of plasticizers on cardiac gap junction intercellular communication (GJIC) using a novel imaging application.

Studies were performed with cardiomyocytes differentiated from human-induced pluripotent stem cells. Samples were treated for up to 7 days with phthalates, MEHP (60 or 120 uM) and DEHP (39 or 50 ug/mL), or positive control heptanol (.25 mM). Cells were stained with Calcein-AM dye for 30 minutes at RT and before imaging. Recovery after photobleaching was quantified and used as a measure of disruption to cellular communication.

Fluorescence recovery after photobleaching is a novel tool to assess the functionality of gap junctions. After photobleaching, small molecular weight dyes can easily pass through functional gap junctions of cardiomyocytes that are well coupled to neighboring cells. As such, fluorescence recovery can be used to quantify GJIC. Low dose 60 uM MEHP had minimal effects on fluorescence recovery, whereas low dose 39 ug/mL DEHP delayed fluorescence recovery – but this effect was not observed until later time points (7 days treatment). In comparison, high doses of both MEHP and DEHP significantly impaired fluorescence recovery at the earliest time point tested (1 day). This recovery pattern closely resembled that of Heptanol, a known gap junction uncoupler. These results suggest a possible mechanism of action for plasticizer toxicity is by decreasing cell-cell communication through uncoupling of cardiac gap junctions.

Biomedical Engineering

School of Engineering and Applied Science

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RESEARCH MENTOR/DEPARTMENT CHAIR

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ABSTRACT

Discrimination Between Papillary Renal Cell Carcinomas and Cysts in CT Using Machine Learning

Papillary Renal Cell Carcinomas (pRCC) are the second most common type of renal cell carcinomas. They grow in the tubules of the kidneys where blood is filtered and the urine is formed. Due to the homogeneity of these tumors, they can often be difficult to differentiate from cysts in CT images. Currently, biopsy must be performed in order to diagnose a mass as either a cyst or a tumor. Not only is biopsy invasive, but can lead to further complications. The goal of the research was to determine whether cysts and pRCC's in the tubules of the Kidney could be correctly classified using machine learning and the CT images. Images, both cysts and pRCCs, were segmented by Radiologists. Matlab was then used to extract features from the images. The features extracted included both histogram features and texture features (20 gray-level co-occurrence features and 11 gray level run length features). The p-values and AUC values were calculated for each individual feature to determine the level of significance. Features were then used to train classification algorithms, which included KNN, Support Vector Machine, Random Forest, and a variety of Boosted Decision Trees. The features used and parameters of each classifier were optimized to achieve higher levels of accuracy. Classification Accuracy was found to exceed 0.85.

Biomedical Engineering

School of Engineering and Applied Science

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RESEARCH MENTOR/DEPARTMENT CHAIR

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ABSTRACT

PRKCBP1 inhibits HIF-1α Activity in Cardiomyocytes: A Mechanistic Approach

Hypoxia inducible factor 1-α (HIF-1α) is a transcription factor that directs the hypoxic response, including the activation of cell survival pathways, angiogenesis, metabolism, tumor metastasis, and apoptosis.HIF-1α is an important therapeutic target as it is involved in numerous pathologies including, but not limited to, ischemic cardiovascular diseases, diabetes, Von Hippel-Lindau syndrome, and cancer. Previous work has shown that Protein kinase C Binding protein 1 (PRKCBP1) has a negative regulatory effect on HIF-1α target genes, likely due to chromatin remodeling masking binding sites of HIF-1α on hypoxia response elements (HRE). If HIF-1α activity can be regulated, the proliferation of tumor cells and ischemic disease of the heart can be minimized. By determining the histone modifying enzymes that PRKCBP1 recruits to exert its effects on chromatin to induce this inhibition, a better understanding of the mechanism by which PRKCBP1 is able to inhibit HIF-1α activity can be deduced.

Biomedical Engineering

School of Engineering and Applied Science

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ABSTRACT

Breast Cancer Tumor Detection Via Analysis of Thermal Signatures Over Time Using Bottom-Up Quadrant Analysis

Breast cancer is a disease with the highest incidence and mortality among women, with early detection directly correlated to increased survival. However, mammography has been found to fail at detecting small tumors and tumors in women with dense breasts, which are comprised of relatively more breast tissue than fat. When imaged with mammography, fat appears black while both breast tissue and tumors appear white. For this reason, the lack of contrast in dense breasts makes it difficult for radiologists to detect small tumors. Thermography is an imaging technique that utilizes infrared wavelengths ($8-12\mu$) to create an image that correlates image pixel intensity with object temperature. In breast cancer, tumors often experience reduced vasoconstriction compared to normal parenchyma, a process that, as the breast cools, can create a difference in energy dissipation between the normal and cancerous tissue. This indicates a higher local temperature, which in turn can be detected by a thermogram. In this experiment, patients with unilateral breast cancer were imaged with an N2 Infrared camera for 15 minutes. Each thermal image was cropped and manually segmented using MATLAB to separate the breasts from surrounding regions. The manually segmented images were then sorted as either tumorous or healthy breasts. In MATLAB, images were separated into quadrants based on nipple location. The quadrants were labelled to conserve symmetry between the two breasts along the sternum. The average temperature was calculated based on pixel intensity of each quadrant. Then, each quadrant was divided into 4 even sub-quadrants. The average temperature of this second set of quadrants (16ths) was recorded and the process of quadrant division was replicated again among the 16ths quadrants to find the average temperature of 64ths. These steps of quadrant division and temperature detection were repeated for each time interval for each of the 13 patients. Researchers then searched for consistency among maximum temperature locations along the 64ths division and then moved up to 16ths and 4ths to locate a tumor region. This utilized a bottom-up analytical approach to tumor detection. Detected tumor locations from this experiment were compared with truth data provided by surgeons, who recorded tumor size and distance from the nipple. This research is ongoing.

Biomedical Engineering

School of Engineering and Applied Science

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ABSTRACT

Ultrasound Contrast Agents: Effects of Shell Chemistry on Acoustic Response of Lipid-coated Microbubbles

Microbubbles have been widely used as contrast agents for ultrasound imaging. They are also being investigated for therapeutic applications including as a vehicle for ultrasound activated targeted drug delivery. Here the effects of the shell chemistry on the acoustic response of microbubbles have been investigated. Microbubbles encapsulated by a lipid shell (DPPC and DPPE-PEG2000) were prepared with different PEG molar ratio (0 to 20%) investigating their concentration, size distribution, and material properties. Note that different PEG concentrations were previously shown to result in different PEG surface configuration: mushroom for 0-5% PEG and brush for 10-20% PEG.

Optical microscopy was used to measure the concentration and size distribution of microbubbles. It was shown adding PEG to the lipid shell will increase the number concentration of microbubbles. The highest measured concentration was for 2%PEG shell, while further addition of PEG into the shell encapsulation resulted in gradual decrease in concentration.

Acoustic characterization was used to determine the material properties of the phospholipid shell. Resonance frequency of the microbubbles was measured through frequency dependent attenuation coefficient measurement. It was found that the microbubbles with shells in mushroom regime have higher resonance frequency around 5-6 MHz, while microbubbles in brush regime resonate around 1-2 MHz. A linearized mass-spring like version of a modified Rayleigh-Plesset model for bubble dynamic, Exponential Elasticity Model (EEM), was used to fit the experimental attenuation measurements for estimation of material property. It was shown that the elasticity of the phospholipid shell decreases with increasing of PEG percentage.

As ultrasound imaging contrast agents, acoustic response of microbubbles are of great importance. The acoustic response of microbubbles with different shell composition were also investigated by using 2.25 MHz transmitter and broadband receiver transducers. It was shown that microbubbles in the brush regime generate higher fundamental and subharmonic scattering components at 2.25 MHz excitation, while the higher harmonics seems unaffected.

The findings show that higher inclusion of PEG in phospholipid shell leads to lower elasticity of the encapsulation which in turn makes microbubbles to resonate at lower frequencies. This is due to the disruption in the base lipid microstructure caused by addition of PEG emulsifier. By considering this fact, proper selection of microbubbles for specific biomedical ultrasound applications would be possible.

Biomedical Engineering

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ABSTRACT

Anti-Melanoma Effect of Physical Cold Atmospheric Plasma Treatment

Melanoma is responsible for a large number of deaths from skin cancer and the success of treatment largely depends on the cancer's stage. Many treatment options are available for melanoma, however, there's always a need for more effective, non-invasive therapies. Plasma medicine is relatively new in oncology but has been used in wound healing, sterilization, and cell/tissue removal. When it was discovered that plasma can selectively target and destroy cancer cells without damaging normal cells, its use as a cancer therapy gained attention. Cold atmospheric plasma (CAP), also known as non-thermal plasma, is an ionized gas composed of reactive species, electrons, ions, and neutral particles. CAP has both chemical and physical properties. The chemical effect of CAP has been vastly studied and is characterized by reactive oxygen and nitrogen species causing cancer cell death. The physical effect of CAP is based on physical factors such as electromagnetic waves, ultraviolet radiation, and heat production, but isn't well understood.

In this study, we compared the effect of chemical CAP versus physical CAP treatment on B16F10 melanoma cancer cell morphology and viability. Cells were cultured in 12 well plates or 35mm, 60mm, and 100mm dishes for one day. Cells then underwent chemical treatment, directly treating cells in media, or physical treatment, non-thermal plasma applied to the back of the plate or dish without media. The physical effect of CAP resulted in greater growth inhibition and cell death compared to the chemical effect. A new type of cell death was noted in physically treated cells characterized by rapid bulk leakage of water from the cells. Florescent imaging also demonstrated gradual loss of DNA and degradation of cytoskeleton after physical CAP treatment.

Further investigation of individual physical factors of CAP showed that a copper sheet blocking electromagnetic emission of CAP negated the cell death previously seen with physical treatment. The impact of various parameters of the CAP device such as distance from the jet, discharge voltage, and flow rate of Helium on effectiveness of physical treatment was also tested. The results indicated that an optimal range for each parameter in which physical treatment is most effective on eradicating B16F10 cells exists.

Data gained from this study implies that the mechanism of CAP is more intricate than solely the role of reactive species. Achieving a more complete understanding of chemical and physical effects of CAP treatment will allow for greater translational use of this therapy.

Biomedical Engineering

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ABSTRACT

Wireless, Battery-Free Subdermally Implantable Photometers for Chronic Recording of Neural Dynamics

Genetically encoded calcium indicators (GECIs) that allow scientists to study cellular processes with high specificity have revolutionized our ability to understand complex neural networks. By recording cellular dynamics in freely moving animal subjects, scientists can obtain even more insightful information into brain function such as mechanisms of social interaction and aggression. However, currently available technology involves the use of implantable telecommunication-grade optical fibers connected to external hardware that deliver optical stimuli and retrieve fluorescent signals from GECIs. These optical fibers restrict natural behavior, cause micromotions that damage the neuronal interface, and limit social interaction studies due to fibers tangling. Furthermore, tethered optical fibers limit experimental paradigms to only two-dimensional arenas. Here, I will present our progress in designing highly miniaturized, wireless, battery-free subdermally implantable photometry systems for chronic recording of neural dynamics in small animals. Those systems contain an injectable probe wirelessly powered by magnetic resonant coupling to stimulate and optically record calcium transients from GECIs. By implementing highly miniaturized electronics with energy harvesting capabilities, the photometers avoid the drawbacks associated with tethered optical fiber systems. The use of off-the-shelf components that are compatible with magnetic resonant imaging and computed tomography permits advanced functional and structural analysis studies in addition to high reproducibility. This technology allows for complex experiments such as swim tests that are otherwise not possible with existing technology, suggesting a potential for widespread use in neuroscience research.

Biomedical Engineering

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ABSTRACT

Adverse Events of After-loading High Dose Rate Brachytherapy Reported to the United States Food and Drug Administration (FDA)

OpenFDA is an open access database maintained by the United States Food and Drug Administration (FDA) that provides information on adverse events related to medical devices, such as high dose rate after-loading brachytherapy (HDR-BT). We seek to report and categorize the adverse events related to HDR-BT.

The OpenFDA was queried for adverse events related to HDR-BT between 1993 and 2019. An academic brachytherapist reviewed all reports and categorized events based on disease site, type of applicator, manufacturer, event type, impact on radiation dosimetry, and patient outcomes. Important findings and observations are reported in quantitative and qualitative forms. As this study is observational, no attempt was made to statistically differentiate rates of events between disease sites, applicators, manufacturers, and outcomes.

72 adverse events were reported between 1993 and 2019, with the number of events declining after 2014. 48.9% of events reported a device malfunction, while 27.4% of events reported an injury. Breast balloon implants were the most common applicator involved in events (38.7%). The most common disease site of reported events was Breast (49.2%), followed by Gyn (23.7%). Applicator breaks caused the majority events (64.2%), and user error contributed to only 16.7% of events. 24.7% of patients received an incorrect radiation dose as a result of the event, and 16.4% required additional procedures to rectify the adverse event. 11.0% of events required repair of the afterloader. 3.0% of events resulted in unintended radiation dose to staff. There were no reported staff injuries or patient deaths from an adverse event in this time period.

The OpenFDA database shows a decreasing trend in adverse events of HDR-BT. Most adverse events are not caused by user error, and most events do not result in patient injury or incorrect radiation dose. These results support the continued use of HDR-BT as a safe treatment modality for cancer.

Biomedical Engineering

School of Engineering and Applied Science

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ABSTRACT

Cerebrovascular Event Detection Robotic System: Rob Bitt

As the growing elderly population becomes a greater issue in society, new technologies such as socially assistive robots (SAR) are being considered as an alternative care-taking approach, giving the elderly more independence and safety. Stroke is the fourth-leading cause of death in America, and its complications can be greatly reduced by decreasing the medical response time. We present a robotic system named "Rob Bitt," a stroke detection companion that continuously monitors a patient's condition in order to detect signs of potential cerebrovascular events and automatically activate an emergency response, reducing medical response time. The robotic system utilizes the Emergency Medical Services' (EMS) Facial Droop, Arm weakness, Speech, and Time to call 911 (FAST) protocol for cerebrovascular event detection. EMS protocol is initiated when the user reports feeling unwell in addition to having abnormally high blood pressure, after which the robotic system is capable of concluding if the user is at risk. Rob Bitt automatically performs all of these functions while providing friendly daily interactions via a chat bot and sentiment analysis. The robotic system is capable of providing a health record of the user's measured blood pressure and sentiment, which can be beneficial for adjusting posology and providing additional support to the user through a doctor or therapist. The proposed robotic system's EMS response protocol is composed of a novel classification model capable of discerning facial droop, and the chat bot and deep learning was created in order to analyze the sentiment of the user. These are all managed by a state machine that reflects the need of the user. In addition to this, daily user-robot interactions were designed in order to promote happiness between the user and robot. The system was tested on the Ubuntu operating system, and the three main functions of the robotic system were tested. The accuracy of the listening function, negative sentiment prediction, positive sentiment prediction and stroke detection algorithm were performed, in addition to testing the number of attempts necessary for the listening function to detect an input. A pilot study was conducted under GW IRB #051616 with 2 human participants. Rob Bitt, a novel stroke detection robotic system developed and tested in this study showed that it is possible to detect stroke event with the help of a simple robot. Rob Bitt is capable of decreasing time until detection of the stroke event and significantly reduce rehabilitation complications.

Biomedical Engineering

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ABSTRACT

Optimal Parameters for Optogenetic Activation of Intrinsic Sympathetic Cardiac Neurons

Sympathetic neuron activity is thought to be a major cause of deadly arrhythmias, yet this mechanism is difficult to study in live patients. Fortunately, technological advances in optogenetics and transgenic mice provide the ability to study sympathetic nerve activation in animals. A transgenic mouse model that expresses channelrhodopsin within catecholaminergic neurons enabled photostimulation of sympathetic neurons within the heart to study the time course of neural control of cardiac function. This photostimulation approach provides unparalleled spatial and temporal specificity of cardiac neuron activation that cannot be achieved with electrodes. A goal of this study was to measure how the pulse rate of sympathetic neuron photostimulation alters heart rate. A second goal was to determine if a perfluorocarbon based perfusate reduced the incidence of arrhythmias during neuron photostimulation due to increased myocardial oxygen delivery.

Catecholaminergic neurons in excised Langendorff perfused mouse hearts were selectively photoactivated with a micro LED. Heart rate response at increasing illumination pulse rates (frequencies) were assessed via the ECG. Photoactivation induced sudden increases in heart rate that positively correlated to photostimulation frequency, and higher frequencies often caused arrhythmias. Photostimulation was repeated using a perfluorocarbon (PFC) perfusate to determine whether increased oxygen concentration would combat arrhythmia when neurons were pulsed at high frequencies.

Consistent increases in heart rate were observed when neurons were photostimulated using pulse rates from 5-15Hz. Hearts perfused with perfluorocarbon perfusate maintained high heart rates and appropriate coronary flow for at least an hour, indicating that PFC perfusate is comparable to the conventional perfusate. The shelf life of the PFC perfusate was monitored daily over a week by measuring PFC droplet size and solution osmolarity. These values were found to be constant over one week. Studies are currently ongoing to measure how hearts respond to neural photostimulation when perfused with PFC perfusate. Preliminary observations indicate that hearts may be more sensitive to neural stimulation when perfused with PFC perfusate. Overall, our results are providing insight into the time course of acute changes in heart rate upon sudden activation of cardiac sympathetic neurons, and the best experimental approach to study the heart's response to sympathetic stimulation, including the induction of deadly arrhythmias.

Biomedical Engineering

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ABSTRACT

Encapsulation of 5-Azacytidine in PLGA Nanoparticles for Improved Drug Delivery in the Treatment of Ovarian Cancer

Ovarian cancer is a deadly disease with extremely limited options for effective treatment. The development of ascites in the peritoneal cavity of the ID8 mouse model of ovarian cancer closely mimics late-stage ovarian cancer in women, making it a useful model to study this disease. Preclinical research in this model shows that 5-Azacytidine (Aza) is an effective treatment as demonstrated by reduced tumor burden; however, this drug is rapidly metabolized (half-life of about 30 minutes at body temperature) and needs to be administered often. Designing nanoparticles for drug delivery can improve efficacy of a rapidly metabolized drug such as Aza by increasing its bioavailability through sustained release. We aim to improve drug delivery of 5-Azacytidine by encapsulating it in PLGA nanoparticles through nanoprecipitation. Nanoprecipitation involves adding a polymer, dissolved in an organic solvent, dropwise into a surfactant. We have concluded that the nanoprecipitation method for synthesis leads to consistent results in comparison to the emulsion evaporation method. The nanoparticles were then characterized for size/polydispersity and surface charge (zeta potential) using dynamic light scattering. UV-vis spectroscopy was additionally used to characterize encapsulation efficiency and drug loading. Our encapsulation efficiency and drug loading studies demonstrate encapsulation of Aza, as determined by UV-vis spectroscopy. Our studies demonstrating nanoparticle size, polydispersity and stability show optimal values and consistency, as determined by DLS. In vitro studies demonstrating efficacy are currently ongoing to test whether Aza nanoparticles can effectively kill ovarian cancer cells. In the clinic, Aza is also given daily, so sustained release would allow for less frequent injections, thus increasing patient comfort and compliance. Having successfully synthesized our nanoparticles, we are testing them in vitro with ID8 mouse ovarian cancer cells to assess release kinetics and validate effective Aza encapsulation. Further studies include assessing DNA Methyltransferase 1 (DNMT1) protein levels and 5-methylcytosine levels using the therapeutic, low-dose equivalent, of Aza PLGA nanoparticles used in vitro. Over the course of 5 days, we expect to see comparable levels of DNMT1 protein and 5-methylcytosine for cells treated with Aza PLGA nanoparticles once, in comparison to the standard 500 nM Aza dose for cells treated daily.

Biomedical Engineering

School of Engineering and Applied Science

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Sharon George

ABSTRACT

Differential Electrocardiographic Response to Doxorubicin treatment in Conscious versus Anesthetized Mice

Doxorubicin, DOX, is an anti-cancer drug used in chemotherapy. DOX causes DNA fragmentation and generates free radicals and causes cancer cell apoptosis. DOX also causes significant cardiotoxicity and heart failure. This study investigates cardiac function modulation in mice treated with DOX, in conscious and anesthetized state.

 C57BL/6 (wild-type) mice, males and females, are injected with saline or 30 mg/kg DOX at ~15 weeks of age. ECGs were recorded 5 days post-injection. Conscious ECGs were recorded using emka Technologies ECG tunnel device, and anesthetized ECGs were recorded using the Vevo Visualsonics ultrasound machine mouse platform. Mice were anesthetized using isoflurane (1 to 2.5%). ECGs were analyzed using a custom Matlab software to determine P, PR, QRS, QTc and RR intervals as well as heart rate variability (HRV) parameters such as SD1 and SD2.

Significant differences in ECG parameters were observed between conscious and anesthetized ECGs recorded from the same mouse. P wave and QTc shortening were observed in addition to PR and RR interval prolongation in anesthetized versus conscious male and female mice.

Additionally, ECG response to DOX was also different between conscious and anesthetized state. While QTc interval was prolonged by DOX treatment (82% versus saline) in anesthetized female mice, no change in QTc by DOX were detected in conscious female mice (3% versus saline). The opposite QTc response to DOX treatment was detected in male anesthetized and conscious mice (6% vs 112% in anesthetized and conscious states, respectively). Similarly, QRS prolongation was observed in conscious female mice treated with DOX (22%) versus saline, but this detrimental phenotype was not observed in anesthetized female mice. HRV, another metric of arrhythmia susceptibility was also different in DOX-treated mice, in conscious versus anesthetized state. In conscious male mice, SD1 and SD2 (short- and long-term HRV parameters, respectively) were increased by 145% and 96%, respectively, in response to DOX. Increased HRV parameters correlated with increased mortality in this group. Changes in HRV parameters were not significant in female anesthetized mice or in conscious mice of either sex.

While RR prolongation is a widely-known effect of isoflurane anesthesia on the ECG, this study reports that the effect of isoflurane extends to other ECG parameters as well. Furthermore, this study for the first time identifies that the ECG response to DOX is different in conscious versus anesthetized state. This finding can have significant implications on clinical diagnosis of DOX cardiotoxic effects.

Biomedical Engineering

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Luyao Lu

ABSTRACT

Bidirectional Optoelectronic Interfaces for Recording and Modulation of Biological Systems

Recent advances in optophysiology tools such as optogenetics have expanded and revolutionized biological research. Combining optogenetics and gold standard extracellular recording will allow simultaneous modulation and monitoring of cellular activity. However, bidirectional systems that can both deliver light to regions beneath the recording electrodes and perform high spatiotemporal resolution recording remain rarely explored. Here, I will present monolithic integrated multifunctional devices consisting of transparent microelectrodes and microscale light sources to enable simultaneous co-localized electrophysiological recording and optical modulation. The transparent microelectrodes exhibit high transmittances, superior electrochemical impedance, and minimized light-induced electrical artifacts for crosstalk-free high-fidelity electrophysiological recording. I will further discuss ex vivo studies on transgenic mouse hearts to demonstrate the multifunctional capabilities of our devices in electrical recording and optical pacing to treat abnormal heart rhythm at the same anatomic site. These microsystems have broad potentials for widespread biomedical applications in both basic and translational research.

Biomedical Engineering

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ABSTRACT

Estimation of Tissue Oxygen Saturation via Hyperspectral Imaging Aided by Monte Carlo Simulation

This study presents the use of data-driven approaches and a Generalized Modified Beer-Lambert (GMBL) law based least square method in the prediction of tissue oxygen saturation (SO2) via hyperspectral imaging. They have the advantage of noninvasive measurement and can overcome the limitations of using a conventional signal processing approach, Modified Beer-Lambert (MBL) law-based least square method, that is computationally expensive and has limiting assumptions. The Monte Carlo Simulation was adopted to simulate light propagation in a two-layer tissue medium in which the blood-free epidermis layer of thickness 100 μm was supported by a semi-infinite dermal layer. We simulated 280 sets of diffuse reflectance spectra across a wavelength range 520 nm to 650 nm with a step size of 10 nm. Gaussian white noise was then incorporated onto the simulation data to produce signals with signal to noise ratio of 30 dB. Models used in this study are Linear Regression, Neural Networks (Artificial Neural Network and Recurrent Neural Network), Support Vector Regression and GMBL law-based model. This study found the lowest mean absolute error 0.195 ± 0.126 using the Support Vector Regression model with 10-fold-cross-validation; this compared favorably to the GMBL law-based model, which had a mean absolute error of 1.696 ± 1.255. This work showed that the data-driven approaches could provide accurate measurement of blood SO2 and promote further advancement in the current technology specifically in the development of a portable and non-contact SO2 measurement systems.

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ABSTRACT

3D Printing of Human Corneal Epithelial Cells for the treatment of Limbal Stem Cell Deficiency, Optimization of Material Properties and Cellular Conditions

One of the major causes of blindness across the world is Limbal Stem Cell Deficiency (LSCD). Patients who suffer from LSCD are unable to regenerate limbal stem cells which prevents them to regenerate the corneal epithelium. Due to this, they experience chronic inflammation, corneal neovascularization, and blindness due to an opaque covering on the cornea. Previous studies have demonstrated that skin derived cells are able to regenerate the corneal epithelium, and preliminary studies have shown the potential of unmodified ABCB5+ DSC for corneal regeneration in the setting of experimental LCSD. We hypothesize, that ABCB5+ DSC might represent a different possible source of stem cells to regenerate the corneal epithelium. Additionally, we are examining if corneal regeneration in LSCD patients could be enhanced with bioprinting of human corneal epithelium cells and ABCB5+ dermal stem cells. In this study, we optimized the properties of cellular components (Human Corneal Epithelial Cells) for bioprinting and properties of the bioprinting material TISSEEL for use with our custom-designed 3D bioprinter.

Biomedical Engineering

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Chung Hyuk Park

ABSTRACT

Behavior-based Risk Detection of Autism Spectrum Disorder Through Child-Robot Interaction

This work presents a method to identify children at risk for Autism Spectrum Disorder (ASD) using behavioral data extracted from video analysis of child-robot interactions. Specifically, we used facial expressions and upper body movement patterns for this purpose. We designed a robot-assisted interaction that used robots as a tool to elicit social engagement from the children in order to capture their social behaviors. The interaction scenario utilized two robots (a humanoid and a non-humanoid robot) in a sensory maze setup in an activity that was designed to include various opportunities for conversations initiated by the robot, encouraging active participation from the child to facilitate a joint sensory experience.

A user study was conducted to collect a video dataset from 12 children between the ages of 5 and 10 years, divided into two different groups of typically developing (TD) children and those with ASD. We extracted upper body skeletal data and facial keypoints from the video recordings of the interactions using OpenPose and used Laban movement analysis to derive features that can be used to analyze the intent behind human movement (weight, space and time). The 3 derived movement features were combined with 68 facial key-points to form a dataset comprising a total of 71 features.

These multimodal behavioral data were used to train a Convolutional Neural Network (CNN) in order to evaluate the utility of proposed approach for ASD risk detection in children. The goal of ASD risk detection was modeled as a binary classification problem. The CNN was trained on 80% of the interaction data and the remaining 20% were used to validate its performance. The CNN achieved a training accuracy of 0.883 and a training loss of 0.232. Two additional machine learning classifiers (Random Forests and K-Nearest Neighbor) were used to situate the performance of the CNN by comparing their accuracy, precision, and recall values.

All 3 classifiers attained high accuracy, precision, and recall values that were close to 0.90. These results were encouraging, given the small size of the training dataset (on average ~18597 data points per subject). Given the false negative value of 0.1787, this method cannot be claimed to be ready to be used singularly as a diagnostic tool for ASD. However, this proposed behavioral approach can be useful as a more accessible layer of screening to identify at-risk children and streamline the diagnosis process.

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Igor Efimov

ABSTRACT

Library of Human Heart Promoters and Enhancers

Regulatory elements play a crucial role in cell differentiation and developmental processes, while SNPs in promoter and enhancer regions are linked with hereditary diseases. A significant amount of transcriptional regulation at the level of cis-regulatory elements through transcription factor (TF) binding to specific promoters and enhancers affecting transcription of the target genes and the phenotype. Cap analysis of gene expression (CAGE) is a transcriptomics approach that allows transcription start site (TSS) localization for promoter identification as well as its high sensitivity allows catching expression of short-lived RNA species like eRNA. Despite previous studies focusing on the identification of regulatory elements in the human genome, there is no comprehensive collection of cardiac-specific promoters and enhancers that include all four cardiac chambers (right and left atria and ventricles). Here we have constructed a fully annotated and validated library of promoters and enhancers using CAGE.

Tissue was collected from human donor hearts whose cause of death was determined to be non-cardiogenic. Collection sites were following left atrium (LA), right atrium (RA), left ventricle (LV), right ventricle (RV), and right ventricular outflow tract (RVOT). Sequencing was performed in RIKEN institute following CAGE protocol. Data was analyzed following previously published CAGE promoter and enhancer analysis pipelines. Classification for true TSS was done using Eukaryotic Promoter Database (EPD). SNPs related to cardiac diseases were identified from genome-wide association studies (GWAS) database.

We have identified 9594 novel CAGE peaks (42k in total), where 1472 classified as TSS and 1444 novel enhancers which were validated with ChIP-seq and motif enrichment analysis. Additionally, we created an interactive library that allows separating tissue level regulatory elements into cell-type-specific promoters by using the FANTOM5 cell culture database. We have also found that over 25% of SNPs from GWAS related to cardiac diseases are located around the TSS region of the promoter which points to a heritable component of origin of those SNPs in the non-coding region.

Understanding the regulatory network of transcription regulation, defining master regulator genes helps perform expression regulation of numerous genes with minimal expenses in medical and biotechnology studies. Although there are limitations of this method in terms of capturing truly all biologically functional regulatory elements and there is no one-size-fits-all approach towards their identification, CAGE remains to be one of the most precise methods of large scale TSS identification.

Biomedical Engineering

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Chung Hyuk Park

ABSTRACT

Dance with a Robot: Encoder-Decoder Neural Network for Music-Dance Learning

Music can act as a soul for a dance. The basic components of music, such as beat, rhythm, and flow can be the natural source of dance choreography. Since dances are effective social skills, the combination of music and dance can also play effective roles in social interactions. Therefore, a music-to-dance synthesis mapping algorithm could be beneficial in applications targeting music-based dance teaching, social-behavioral learning, and communication skills development in social interactions. In this study, we present a method for learning sequential and temporal mapping between music and dance via Sequence-to-Sequence (Seq2Seq) neural network architecture. Seq2Seq model is based on the recurrent neural network (RNN), which comprises two parts: the encoder for processing the sequential music inputs and the decoder for generating the sequential output motion vectors. This model has the ability to accept music features and motion inputs from the user for human-robot interactive learning sessions, which outputs the motion patterns that teach the corrective movements to follow the moves from the expert dancer. We sample the dataset from the expert dancer in a teaching video with music, then map the input movement sequences from the video and the music features from the music of the video, to the output sequence that are the continuous motion features from the dancer by using the Seq2Seq model. In the training phase, we train the model by using the motion features from the expert dancer, while, in the teaching phase, the trained encoder and decoder models correct the user's motion input. Three different types of Seq2Seq models are compared in the results. Finally, the model's outputs are applied to a robot platform, NAO, for demonstration for social interactions. The proposed system can run in real-time on a computer equipped with Nvidia RTX 2080 Ti graphics card. This study will be applied in social interaction scenarios with children with autism spectrum disorder (ASD).

Biomedical Engineering

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ABSTRACT

Ultrasound-Enhanced Ocular Drug Delivery for Treatment of Acanthamoeba Keratitis

Bioavailability of ocular drugs has posed a significant challenge in ophthalmology due to the various anatomical and physiological barriers and the unique biochemistry of the eye. Usually, less than 5% of therapeutic agents make it through the cornea due to corneal epithelium barrier properties, normal tear production, and blinking. Acanthamoeba keratitis (AK) is a rare but serious parasitic infection of the cornea that can lead to permanent vision loss or blindness if not treated properly. This disease is mainly seen in tropical regions of the developing world, but it has been on the rise in the United States where it is estimated that 85% of cases occur in contact lens wearers. The aim of this study was to determine the efficacy and safety of using ultrasound to increase transcorneal drug delivery of 1% polyhexamethylene biguanide (PHMB), a standard ophthalmic drug used for treatment of AK.

Dissected corneas of adult rabbits were used in our experiments because of their similarity to human eyes. The corneas were placed in a diffusion cell between a donor compartment filled with 1% PHMB and a receiver compartment filled with Dulbecco's phosphate-buffered saline. Each cornea was exposed to the drug solution for 60 minutes, with the experimental group receiving 1 - 5 minutes of continuous ultrasound or 5 minutes of pulsed ultrasound at 25% duty cycle in the beginning of treatment. Unfocused circular ultrasound transducers were operated at intensities of 0.5 W/cm^2 or 0.8 W/cm^2 and frequencies of 400 kHz or 600 kHz. To ensure optimal energy delivery, transducers were placed at the transition point from the near field to the far field, calculated to be 1.5 cm and 2.25 cm for 400 kHz and 600 kHz respectively. Diffusion cells were placed in a water bath kept at a constant temperature of 34°C throughout the duration of treatment. Histological images of the cross-section of the cornea were used to assess the structural changes due to ultrasound exposure.

We observed increased drug delivery in each experimental group. The greatest increase seen was 2.36 times ($p < 0.001$) with 5 minutes of continuous ultrasound at 0.5 W/cm^2 and 600 kHz. Histology observations showed disorganization present in the first 2-3 layers of the corneal epithelial, with the stroma and endothelium remaining unaffected. This study suggests the possibility of ultrasound as a novel drug delivery technique that can contribute to the eventual development of an inexpensive, effective, and minimally invasive treatment for AK.

Business

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David Costanza

ABSTRACT

The Use of AI integrated Asynchronous Video Interviewing and Its Impact on Applicant Reactions: A Case Study of Unilever & Hirevue's Partnership

The purpose of this study is to examine how the use of AI embedded asynchronous video interviewing in organizational selection procedures impact applicant reactions and subsequent organizational outcomes. Asynchronous video interviewing (AVI) is used to describe one-way interviews wherein an applicant records and submits a video of themselves answering a subset of predetermined questions having no interaction with an interviewer. AI embedded AVI takes it a step further by using machine learning and algorithms to analyze the applicant's tone, speed, cadence, etc. to compute a fitness score.

Given what the existing literature shows on applicant reactions and procedural justice perceptions this style of interviewing could lead to a number of undesirable organizational outcomes such as candidate attrition or offer rejections. In order to address the question at hand, research will be conducted through the form of a case study on the partnership between Unilever and Hirevue. Unilever redesigned their graduate recruitment program in 2016, enlisting the help of Hirevue's AVI platform in order to "attract millennials." Various forms of data ranging from public company records and media articles regarding Unilever's new selection procedure will be gathered and coded for elements of procedural justice (e.g. transparency, ability to perform). Said data will then be compared and contrasted against Glassdoor reviews and statistical data from Unilever with the hopes of discovering either trends in applicant reactions, or discrepancies between the literature and its application.

AI and automation continue to gain more commonplace across various aspects of our lives; the traditional way of doing things is being supplemented or replaced entirely by technological advancements, whether it be for the better or worse is still uncertain. This study only merely begins to answer the call for more empirical research on the practical applications of this largely unregulated selection method that has the capacity to impact virtually all workers -- either entering or already in the workforce.

Business

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ABSTRACT

Is it Worth Pondering over Diversity to Facilitate Innovation in Banks?

The case for workforce diversity has become normative; particularly in the financial sector, diversity may play a crucial role in firm-performance. Already in a risk-averse segment of the market, banks are inherently restrained. Diversity of thought is associated with opportunities for greater innovation by individuals who think differently and can introduce novel products/services. However, in the specific setting detailed below, a variable unrelated to diversity seems to facilitate innovation. This begs the question – is it worth investigating whether diverse individuals steer innovation in financial firms? Diversity in banks is three-pronged. First, the dynamic and constantly evolving environment of banks is diverse. Second, facilitating the delivery of these products is a diverse workforce. Third, the varied markets targeted, as well as to products/services offered, are diverse. Thus, the three-pronged diversity – manifested in the environment, employees, and products/services – is worth studying. The design of this study entailed operationalizing diversity using quantitative coding of archival data. A mediated regression-analysis for 70 banks was run to assess relationships between diversity of environment and diversity of workforce, as well as workforce diversity and diversity of products/services offered. Results did not support the hypotheses that environmental diversity is positively correlated with diversity of workforce or with diversity of products/services offered. Intuitively, diversity helps banks' adaptability to change in marketplaces that demand these organizations go beyond conventional limitations set on them, but findings suggest that meaningful relationships among diversity of environment, workforce, and products/services probably do not exist based on the operationalized variables. However, statistical insignificance could have resulted from measurement issues with variables and environmental constraints limiting the impact of diversity. Strict regulatory environments of firms studied restrain resource availability, which may restrict the diversity of products/services offered – the presence/absence of diversity may truly be irrelevant. Environmental diversity may possibly not be a variable, as federal legislation is constant across all institutions. Diversity in age can be operationalized differently by juxtaposing decision-makers in banks with those who generate ideas. Implications of these findings are that other factors impact the variety of products/services offered and targeted organizational interventions addressing the lack of diverse workforces may not be effective in enhancing innovation. This research introduces new knowledge to understand the complex theme of diversity in finance. It is the first known quantitative review on different kinds of diversity in banks and sets the stage for future research.

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ABSTRACT

Employing Postcolonial Theory as a Framework for Creating a More Inclusive Workplace

The business case for diversity rhetoric is commonplace in 2019, suggesting a profit for ensuring equal opportunity in the workplace. Organizations across a multitude of industries as well as academia have invested incredible resources to develop this concept. This article reviews postcolonial theory from multiple perspectives and uses postcolonial theory themes as a framework to explore the reasons why inclusion and diversity business strategies and programs are not seeing the progress originally anticipated. Considering the use of the social justice discourse, themes of postcolonial theory, and humanistic leadership practices, suggestions and recommendations for creating a more inclusive workplace are outlined.

Business

School of Business

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ABSTRACT

International Linkage, Bank Financing, and Firm Innovation

Financing innovation is difficult!

While innovation has been widely accepted as one of the fundamental channels for companies to establish their competitive advantages, and is essential for economic growth, stimulating efficient innovation is not without its challenges. Unlike traditional fixed assets investment, the creation of knowledge, in general, carries large uncertainty and risk, and is time-consuming, while at the same time, inducing extraordinary positive returns.

Prior research has documented that financing innovation investment via the equity market is preferable compared to using debts. However, recent empirical evidence shows widespread use of loans in newly formed high-tech firms, even in firms' very early development stages. In addressing this seeming puzzle, the literature on bank financing and firm innovation identify several channels via which banks could help stimulate firm innovation. These studies generally treat banks as individual and compete with each other in the credit market, little is known whether some inherent characteristics within the banking system could facilitate banks' incentives and abilities to financing firm innovations and growth.

In this study, I explore how international bank linkages could facilitate banks to finance firm innovation. I find robust evidence that borrowing from internationally linked banks causally leads firms to become more innovative, in terms of both quantity and quality of innovation outcomes. Specifically, firms who borrow from internationally linked banks produce 2.2% more patents and achieve 0.6% more influential patents after they borrow from internationally linked banks, compared to firms that do not borrow from internationally linked banks. Firms who experience larger innovation gains borrow more intensively from familiar internationally linked banks and have higher growth opportunities in general.

In testing the mechanisms under which the positive effects of international bank linkage are transferred to firm-level innovation. I found international bank linkages help connected banks share information and screen firms with higher innovation qualities, allowing additional credits available to higher-quality firms in conducting more innovation activities. Overall, the results shed light on the real effects of international bank linkages and the underlying determinants of firm innovations.

Business

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ABSTRACT

An Examination of the Geographic Patterns of Green Technologies

Research indicates that green knowledge can be distinctly different from nongreen knowledge. However, while there is extensive research on the agglomeration of knowledge, the research on the agglomeration of green knowledge is much more limited, and it is unclear whether green technologies are more or less geographically concentrated than nongreen technologies. This paper focuses on exploring if the geographic patterns of green technologies differ from the geographic patterns of nongreen technologies, and if they do, how they differ. We motivate our study by examining green knowledge spillovers and the institutional pressures for developing green technologies. Utilizing US patent data in a study with GIS software and geospatial statistical techniques, we found the following: 1) green technologies are more geographically concentrated than nongreen technologies, and 2) geographic concentrations of green technologies consist of higher quality technologies.

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ABSTRACT

Stakeholders' Reaction to Unethical Events: The Role of CSR Performance

Prior studies have shown that better corporate social responsibility (CSR) performance might lead to less negative market reaction (i.e. insurance effect) onset of a crisis, which generally creates situations with a high level of uncertainty. This study proposes that the insurance-like effect has its boundary; onset of crisis with higher situational attributions, which means that evaluators attribute more responsibility of the crisis to the focal firm, CSR performance might not produce insurance-like effect but even backfire on market reaction based on expectancy violation theory (EVT). By analyzing violation events of Chinese Companies listed in Shanghai and Shenzhen Stock Markets from 2012 to 2016, we find that when unethical events with higher situational attributions occur, the better the CSR performance is, the stronger the negative market reaction will be. Furthermore, we examine two contingency factors and find that the negative market reaction will be stronger if the firm involved in unethical events receives more media attention or the firm is owned by the state.

Business

School of Business

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ABSTRACT

Financial Literacy in Women, Non-Retirement Investing and Behavioral Biases

Investing is generally considered a male-dominated area. Compared to their male coun- terparts, women tend to participate less in making investment decisions. Psychological and behavioral finance research e.g. Barber and Odean (2001) attributes such gender difference to men being overconfident and taking more risks than women. The financial literacy literature e.g. Bucher-Koenen, Lusardi, Alessie, Rooij (2016) in financial literacy documents a similar gender difference: women's financial literacy level is lower than men's, which could explain why women under invest. Clark, Lusardi and Mitchell (2016) point out that financially savvy employees are more likely to participate in defined contribution plans. My study focuses on active investors, instead, those who have investments in stocks, bonds, and other securities outside of their retirement accounts. I find that financial literacy increases participation in non-retirement investing and reduces the bias of overconfidence. Moreover, financial literacy helps women more than men in both areas mentioned above, which could be interpreted as the marginal return of financial literacy for women, a less financially savvy group, is higher than that for men, a more financially literate one. Financial literacy programs, especially those targeted on women, are expected to generate better outcomes in promoting investing outside of retirement accounts and lessening the overconfidence bias among investors.

Business

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ABSTRACT

Limits to Anomalies

In this paper, we study the effect of the existence of options on firms as it pertains to some prominent anomalies such as IVOL, momentum, SUE, turnover, and analyst dispersion. Using a merged sample of Compustat-CRSP, IBES, and OptionMetrics to execute portfolio sorts and Fama-Macbeth cross-sectional regressions, we demonstrate the results for the period encompassing January, 1996 to December, 2016. We find that for optionable firms that do not exhibit high credit risk, not only are these anomalies reduced in magnitude, but rather they cease to exist entirely. Distinct from prior research, we find that for non-optionable firms, the marginal effects are highly significant and persistent, regardless of credit risk. Our results suggest that the effect of anomalies is limited, and is largely driven by the inability to hedge against risk arising from adaptations to the investment opportunity set.

Business

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ABSTRACT

Modeling Power Outages via Markov Modulated Compound Poisson Processes: A Bayesian Approach

Markov processes play an important role in reliability analysis, particularly in modeling the stochastic evolution of survival/failure behavior of systems. The probability law of Markov processes is described by its generator or the transition rate matrix. In this paper, we suppose that the process is doubly stochastic in the sense that the entries in the generator change with respect to the changing states of yet another Markov process. This process represents the random environment that the stochastic model operates in. We have a Markov modulated Markov process which can be modeled as a bivariate Markov process and analyzed probabilistically using Markovian analysis. In this setting, we focus on Bayesian analysis when the states of the environmental or modulating process are unobserved based on observed data on the modulated Markov process. We present a computationally tractable approach using Gibbs sampling. We apply a Markov modulated compound Poisson process to describe the reliability of the power system and the number of people affected by the power outages in Northern Virginia.

Business

School of Business

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ABSTRACT

Better Not To be CSR-washing: The Stock Market Reaction to Multifaceted Firms with a CSiR event

How do shareholders evaluate a firm with an irresponsible event such as product recall? This study aims to understand the relationships between the firm's previous overall and domain-specific CSR and CSiR activities and the stock market reactions to a product-related irresponsible event. One the one hand, the literature on CSR insurance effect argues the positive relationships between CSR and the stock market reaction when an adverse event occurs based on the moral capital. On the other hand, the expectancy violation theory argues that a firm's CSR activities may violate shareholders' expectations and lead to a more severe market reaction in case of an irresponsible event. This paper takes an abductive reasoning approach to reconcile two contradictory theories. First, this study explores how the stock market reacts to the irresponsible event when firms have both positive (CSR activities) and negative (CSiR activities) information. Second, this study considers overall information (overall CSR/CSiR) and specifically relevant information (product domain CSR/CSiR) may differently influence the stock market reaction. Using product-related CSiR events of S&P 500 firms between 2003 and 2012, this study contends that a firm's overall CSiR is negatively associated with the stock market reaction, whereas a firm's overall CSR is not always positively related with the stock market reaction. This study also finds that a firm's product domain-specific CSiR may weaken the negative relationship between the overall CSiR and the stock market reaction because stakeholders may be barely surprised when a CSiR event happens to a "bad" firm. Overall, this study implies the punishment effect of overall CSiR and the ironical cushioning effect of domain-specific CSiR by lowering the expectation of shareholders on firms.

Cancer/Oncology

Institute for Biomedical Sciences (PhD Students in IBS Only)

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RESEARCH MENTOR/DEPARTMENT CHAIR

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ABSTRACT

Designing A Nanoimmunotherapy To Target Solid Tumors

Malignant mesothelioma (MM) is a solid cancer of the mesothelium, which lines internal organs such as the lungs, peritoneum, and heart. It is an incurable disease with an average 5-year survival rate of 8-20%. MM is primarily caused by exposure to asbestos. As such, people that have worked with asbestos, especially US veterans and servicemembers that worked with the mineral, are at increased risk for developing the disease. Adoptive cell therapy has shown great success in treating liquid tumors, achieving long-term remission rates of 70-90% in leukemia patients. However, barriers to treating solid tumors, such as mesothelioma, with this therapy remain, including: 1. Solid tumors secrete immunosuppressive signals, such as TGFbeta, that block immune cell cytotoxicity against tumor cells; 2. NK cells need a near-constant supply of IL-15 to maintain their activation and cytotoxicity against tumor cells; and 3. The dense stroma of solid tumors physically blocks immune cell infiltration. This project aims to develop an adoptive cell therapy to overcome all three of these barriers. We genetically engineered cord blood-derived human NK cells to be resistant to TGFbeta and to secrete their own IL-15. We showed that these cells were unresponsive to TGFbeta, could stimulate their own activation and proliferation, and were more able to kill TGFbeta-expressing mesothelioma cell lines than their wild-type counterparts. We were also able to show that heparanase, an enzyme that breaks down part of the tumor stroma, aids in NK cell invasion in vitro. We then conjugated this enzyme to FDA-approved nanoparticles in order to increase the efficiency of delivery to tumors and prevent its degradation in vivo. Our therapy shows promise in vitro in targeting solid tumors like mesothelioma; our next steps will be to test the efficacy of the heparanase-conjugated nanoparticles in vitro and then move our therapy to in vivo testing.

Cancer/Oncology

Institute for Biomedical Sciences (PhD Students in IBS Only)

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RESEARCH MENTOR/DEPARTMENT CHAIR

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ABSTRACT

DNMTi Plus Anti-4-1BB Therapy Reverses Suppressive Tumor Microenvironment and Reduces Tumor Burden in Ovarian Cancer

Novel therapies are urgently needed for ovarian cancer (OC), the fifth deadliest cancer in women. Better OC prognosis is associated with high tumor-infiltrating CD8 T cells, but OC is generally characterized by an immunosuppressive tumor microenvironment (TME), with less than 10% of patients responding to immune checkpoint blockade therapy in clinical trials. DNA methyltransferase inhibitors (DNMTi) activate transcription of repetitive elements to induce a type I interferon response in OC, which recruits and activates host immune cells to fight the tumor. Additionally, changes in DNA methylation in T cells regulate T cell memory. Thus, DNMTi increase anti-tumor immunity through 1) tumor IFN response and 2) reversal of T cell exhaustion.

To test the hypothesis that combination epigenetic and immune therapy could increase the anti-tumor response in OC, we treated an immunocompetent mouse model of OC with DNMTi +/- anti-CD137. The ID8 MOSE P53-/- model grows intraperitoneally and produces ascites, mimicking human OC which is 90% P53 mutant. The TME of this model is immunosuppressive and it is not responsive to immune checkpoint blockade therapy. At 9 weeks post tumor injection, we observed the following survival percentages: 50% for the combination group, 30% for the DNMTi group, and 0% survival for the both the anti-CD137 and mock groups. We also observed statistically significant increases in %CD3+IFNg+ T cells in the spleen for the DNMTi + anti-CD137 group compared to the mock group. We hypothesize that anti-CD137 treatment is activating immune cells recruited by DNMTi. Future experiments will manipulate cytokine expression to delineate mechanism. We thus describe a novel immunotherapeutic combination for ovarian cancer.

Cancer/Oncology

Institute for Biomedical Sciences (PhD Students in IBS Only)

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RESEARCH MENTOR/DEPARTMENT CHAIR

Alejandro Villagra

ABSTRACT

Evaluating the Role of HDAC6i in Overcoming Resistance to Brafi in Melanoma

Melanoma is the deadliest type of skin cancer, and it is estimated that 100,000 people will be diagnosed in 2020. BRAFV600E mutation is found in ~50% of melanoma patients. Although targeted therapy with BRAF inhibitor (BRAFi) Vemurafenib has shown promising results, some patients do not respond or eventually develop resistance. Therefore, overcoming this resistance and increasing the sensitivity of melanoma cells to BRAFi remains one of the most compelling challenges for these patients. Current efforts include the study of combination therapies that can target multiple pathways, thus increasing sensitivity to these inhibitors and delaying resistance. Epigenetic modifiers, like histone deacetylase 6 inhibitors (HDAC6i), have been studied since HDAC6 regulates multiple pathways that are important for the development of resistance to BRAFi. In this study, we evaluate the role of the ultra-selective HDAC6i Nexturastat A in sensitizing multiple human and mouse melanoma cell lines harboring different genetic alterations to Vemurafenib. Through cytotoxicity and viability assays, our findings suggest that each cell line responds differently to both individual therapies with Vemurafenib and combination therapy, with HDAC6i increasing cytotoxicity and decreasing viability compared to BRAFi alone. We observed that mouse melanoma cell lines harboring a PTEN deletion respond well to the combination therapy with HDAC6i, while the human cell lines show decreased cytotoxicity compared to Vemurafenib alone. These findings suggest that the mutational signature of the tumor could have an effect on the outcome to targeted therapy, and that it should be taken into consideration to maximize the efficacy of the therapy.

Cancer/Oncology

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ABSTRACT

Urinary Morbidity In Men Treated with Stereotactic Body Radiation Therapy (SBRT) For Localized Prostate Cancer Following Transurethral Resection of the Prostate (TURP)

Clinical data suggest that stereotactic body radiation therapy (SBRT) provides similar clinical outcomes as other radiation modalities for prostate cancer. However, data reporting on the safety of SBRT after TURP is limited. Herein, we report our experience using SBRT to deliver hypofractionated radiotherapy in patients with a history of TURP including physician-reported toxicities and patient-reported quality of life.

 Forty-seven patients treated with SBRT from 2007 to 2016 at Georgetown University Hospital for localized prostate carcinoma with a history of prior TURP were included in this retrospective analysis. Treatment was delivered using the CyberKnife® (Accuray Incorporated, Sunnyvale, CA) with doses of 35 Gy or 36.25 Gy in 5 fractions without prostatic urethral sparing. Toxicities were recorded and scored using the CTCAE v.4. Cystoscopy findings were retrospectively reviewed. Urinary quality of life data was assessed using the International Prostate Symptom Scoring (IPSS) and Expanded Prostate Cancer Index Composite 26 (EPIC-26). A Wilcoxon signed-rank sum test was used to determine if there was a statistically significant increase or decrease in IPSS or EPIC scores between timepoints. Minimally important differences were calculated by obtaining half the standard deviation at time of start of treatment.

Forty-seven patients at a median age of 72 years (range 63-84) received SBRT. The mean follow-up was 4.7 years (range 2-10 years). Late Grade 2 and grade 3 urinary toxicity occurred in 23 (48.9%) and 3 (6.4%) men, respectively. There were no Grade 4 or 5 toxicities. Approximately 51% of patients experienced hematuria following treatment. Mean time to hematuria was 10.5 months. Twenty-five cystoscopies were performed during follow-up and the most common finding was hyperemia, varices of the bladder neck/TURP defect, and/or necrotic tissue in the TURP defect. Baseline urinary QOL composite scores were low, but they did not clinically significantly decline in the first two years following treatment.

Cancer/Oncology

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RESEARCH MENTOR/DEPARTMENT CHAIR

Danielle Novetsky Friedman

ABSTRACT

Focal Nodular Hyperplasia in Survivors of Childhood Cancer

Focal nodular hyperplasia (FNH) is a rare liver lesion, accounting for 2% of pediatric liver tumors. Clinically relevant cases of FNH in the US have a reported prevalence of 0.03%. Prior studies have suggested an increased prevalence of FNH in survivors of childhood cancer, but analyses are generally limited by small numbers of patients and short follow-up.

The objective of this study is to describe the demographic and diagnostic variables among a large number of cases of FNH identified in a cohort of childhood cancer survivors treated at a tertiary cancer center.

We performed a retrospective review of childhood cancer survivors at Memorial Sloan Kettering Cancer Center (MSK) with documented FNH on routine surveillance magnetic resonance imaging (MRI). Eligible survivors were: (1) aged ≤21 years at the time of primary childhood cancer diagnosis; (2) diagnosed with childhood cancer between 1990-2017; (3) survived ≥12 months from completion of therapy; and (4) seen in the MSK Long Term Follow Up Program at least once.

We identified FNH in 112 childhood cancer survivors (51.8% male, median age at primary diagnosis: 4.9 years [range: 0.1-21.1]; median follow-up from cancer diagnosis: 11.1 years [range, 4.0-27.8]). The most common primary cancer diagnoses were: neuroblastoma (n=55), sarcoma (n=24), leukemia (n=14), and lymphoma (n=7); 76.2% (n=16) of the leukemia/ lymphoma patients had undergone allogenic bone marrow transplant. Radiographic detection of FNH occurred at a median of 6.7 years (range: 0.8, 22.8) after the primary cancer diagnosis. Twenty-two patients (19.6%) had at least one hepatic comorbidity, including hemosiderosis/hemochromatosis (n=11), hepatic steatosis (n=5), transaminitis (n=2), hepatic fungal infection (n=1), perihepatic abscess (n=1), hepatic hamartoma (n=1), and hepatitis C (n=1). Twenty-nine females (53.7%) were on estrogen therapy. After initial identification of FNH, patients received up to 12 follow-up surveillance MRIs (median: 2) at a median interval of 6 months (range, 1-113). Twelve biopsies of suspicious lesions were performed in 10 patients; all showed benign findings. No patient went on to develop a malignancy of the liver.

This report suggests that FNH may be more common in childhood cancer survivors than in the general population. Based on our institutional experience, the lesions appear to be benign and do not progress to malignancy. Further investigation is needed to identify treatment-related risk factors and optimal frequency of surveillance imaging.

Cancer/Oncology

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Ashkan Monfared

ABSTRACT

Pediatric Rhabdomyosarcoma of the Head and Neck: A National Cancer Database Analysis

Rhabdomyosarcoma (RMS) is the most common soft tissue head and neck sarcoma in children. Despite treatment advances, there has been minimal survival improvements. Anatomic limitations often prevent complete surgical resection, and its role in treatment is debated. All treatments, alone or in combination, are associated with potentially significant morbidity. Stringent analysis of survival data is imperative to guide optimal treatment and minimize long-term functional and cosmetic morbidity. Utilize the National Cancer Database (NCDB) to demonstrate trends in treatment and relative survival outcomes dependent on demographics, primary site, histology, and extent of disease for pediatric rhabdomyosarcoma of the head and neck. The NCDB (2004-2016) was queried for patients ages 0-19 diagnosed with rhabdomyosarcoma of the head and neck. Survival by disease characteristics and treatment was analyzed using log-rank tests, Kaplan Meier, and multivariable Cox-proportional hazards regression. Among 1147 patients identified (63.3% age <10 years, 54.3% male), the majority had embryonal (n=625, 54.5%) or alveolar (n=300, 26.2%) histology. 5-year overall survival (OS) was 70.3% with lower mortality risk for embryonal subtype (adjusted HR [aHR] = 0.69, p=0.0038). Most common treatments included chemoradiotherapy (CRT, 48.0%), surgery followed by radiation (SRT, 31.0%), surgery and chemotherapy (SCT, 6.7%), and chemotherapy alone (CT, 6.2%). Patients with embryonal (aHR = 1.04, p = 0.8522) and alveolar (aHR=1.15, p=0.5206) histology had no difference in mortality when comparing CRT vs. SRT. Most patients had non-parameningeal/non-orbital tumors (n=634, 55.3%), followed by parameningeal (n=303, 26.4%) and orbital (n=210, 18.3%). Orbital tumors had best overall survival (5-year OS=92.4%) compared to other sites but mortality increased with CRT (aHR=6.27, p=0.0302) even after adjustment for all other prognostic factors including extent of disease (defined as local, regional, distant). Parameningeal tumors (5-year OS 58.4%) had no survival difference by treatment (aHR = 0.81, p=0.3576). Non-orbital/non-parameningeal tumors (5-year OS 68.5%) demonstrated improved survival with SRT on univariable analysis (p=0.0408), but not on multivariable analysis (aHR=1.16, p=0.4358). A univariable logistic regression model of treatment type by year identified significant trends in treatment approaches. Probability of SC use increased by 13% yearly (p = 0.0010), while utilization of CA, SRT, and CRT had no significant change. In this cohort, the major prognostic factors for best overall survival were embryonal histology, orbital site, local/regional vs distant extension, and use of SRT for orbital subtypes. Larger population studies are needed to demonstrate survival differences between treatment modalities for other sites.

Cancer/Oncology

School of Medicine and Health Sciences

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ABSTRACT

Role of HDAC6 Inhibition in Adoptive Macrophage Cell Therapy of Melanoma

Tumor-associated macrophages (TAMs) are critical components of the tumor microenvironment (TME), which include antigen-presenting, pro-inflammatory M1-like macrophages (MΦ) with anti-tumor activity, and M2-like MΦs with anti-inflammatory and pro-tumor activity. Therefore, the ratio of M1/M2 MΦs is critical to determine the immune status of a tumor. We previously demonstrated that HDAC6 inhibitors (HDAC6is), when combined with anti-PD1 immune checkpoint inhibitor therapy, increased anti-tumor immunity by decreasing M2 macrophages in the TME. Herein, we present a novel strategy to enhance the M1/M2 ratio by increasing M1 MΦs population with intra-tumor adoptive transfer or by decreasing M2 MΦs with HDAC6i therapy. In this study, we used SM1 murine melanoma cells in C57BL/6 immunocompetent mice, and highly selective HDAC6i, NexturastatA (NextA). Preliminary analysis of tumor volume in SM1 murine model revealed a positive correlation with M2 MΦs underscoring their pro-tumor activity. On the contrary, analysis of TCGA melanoma dataset indicated that expression of M1 markers such as CD80, HLA-DRB1, TRL4, and CXCL10 was associated with a survival benefit. Adoptive transfer of M0, M1, and M2 mouse bone marrow-derived macrophages (BMDMs) with or without pre-treatment with NextA resulted in a significant decrease in tumor growth only with M1 and M1 MΦs pre-treated with NextA (M1+NA) groups. In-vivo analysis of vehicle, M1, NextA, and M1+NA groups indicated that M1+NA group had a better survival rate associated with small tumor volumes. In-vitro, pre-treatment of BMDMs with NextA did not affect the polarization of M1 MΦs but decreased M2 phenotype. Analysis of M1+NA MΦ total RNA by qPCR indicated an increase in expression of M1 markers such as NOS2, IL12B, and antigen processing genes such as TAP1, TAP2, ERAP1, and TAPBP. In M2+NA MΦs, we observed decrease in M2 markers such as ARG1, IL10, TGF, and CCL2, suggesting a decrease in M2 activity. Furthermore, using chicken ovalbumin model and flow cytometry antibodies specific to MHC-I/SIINFEKL, we verified upregulation of antigen presentation in M1+NA MΦs compared to M1 MΦs. Finally, similar results were observed in HDAC6 knock out M1 MΦs indicating that HDAC6 plays an important role in macrophage antigen processing and presentation. Taken together, these data indicate that inhibition of HDAC6 in macrophages can prevent polarization of M2 MΦs and enhance the activity of M1 MΦs. For the first time, we demonstrate a novel macrophage based adoptive cell therapy by epigenetic modulation with HDAC6 inhibitors which has the potential to be applied in solid tumors other melanoma.

Cancer/Oncology

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Ashkan Monfared

ABSTRACT

A National Cancer Data Base Analysis of Head and Neck Paragangliomas

Head and neck paragangliomas (PG) are rare neuroendocrine tumors for which standardized treatment has not been established. This study utilizes a national dataset to update current understanding of presentation patterns and treatment outcomes.

National Cancer Database (NCDB) was queried for patients aged 18 and older diagnosed with head and neck PG from 2004-2016. Survival by extent of disease (local, regional, distant and benign vs. malignant) and treatment (surgery [S], radiation [RT], surgery + radiation [S/RT]) was analyzed using log-rank tests, Kaplan-Meier, and multivariable Cox-proportional hazards regression.

Of 418 patients identified (48.4% <50 years, 42.1% male), 54.8% had malignant disease and 5-year overall survival was 77.2%. Among the most common primary sites, carotid body (CB; n=183; 65% malignant), glomus jugulare (GJ; n=34; 8.8% malignant), and other paraganglia (OP; n=128; 58.6% malignant), there was no significant survival difference on adjusted analysis (p=0.5992-0.9534). For patients with CB, unadjusted analysis was associated with increased mortality in RT vs. S (HR=1.93, p=0.0273), no difference in S vs. SRT (HR=0.78, p=0.4156), and decreased mortality in SRT vs. RT (HR=0.41, p=0.0044). However, no significant survival differences were detected by treatment on adjusted analysis (p=0.5049-0.7119). For malignant disease, mortality risk was higher for RT relative to S (HR=2.82, p=0.0168) and lower for S/RT relative to RT (HR=0.31, p=0.0120) on unadjusted analysis.

Our study demonstrates possible benefit of S/RT over RT in treatment of CB and malignant PG. While low population limited comparative analysis, further characterization of treatment efficacy would be beneficial in establishing standardized treatment.

Cancer/Oncology

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Sidney Fu

ABSTRACT

Integration of microRNA and mRNA Signatures Reveals Gene Networks in Esophageal Cancer

Esophageal cancer (EC), particularly esophageal squamous cell carcinoma (ESCC), is one of the most common cancers worldwide. Diagnostic methods for EC mainly include endoscopy, barium swallow and ultrasound, which is inconvenient and limiting the application, and are either invasive or lack sensitivity and specificity at an early stage. Therefore, development of a non-invasive and reliable diagnostic marker with high sensitivity and specificity could potentially improve cancer screening, diagnosis and treatment. Biomarkers signatures for EC could potentially improve cancer diagnosis and treatment. microRNA (miRNAs) are small RNA molecules that regulate the expression of protein-coding genes by directly binding to target mRNAs in a sequence-specific manner and are thought to be potential biomarkers by regulating the target genes for cancer diagnosis.

miRNAs, mRNAs, and miRNA-mRNA interaction networks were identified in tumor compared to adjacent normal tissues microdissected from ESCCs by miRNAseq and RNAseq. The miRNA-mRNA interactions for human ESCC were identified by Pearson correlation analysis and miRNA target prediction programs.

In the set of differentially expressed miRNAs, 5 and 75 were overexpressed significantly by more than 5 and 2 fold respectively; 1 and 41 were downexpressed significantly ($P = 0.05$) by more than 5 and 2 fold respectively; In the set of differentially expressed mRNAs, 20 and 1839 were overexpressed significantly by more than 10 and 2 fold respectively; 31 and 1230 were downexpressed significantly by more than 10 and 2 fold respectively. The most overexpressed miRNAs are miR-1269, miR-449, miR-525 and miR-196. The most downexpressed miRNAs are miR-3085-3p, miR-375-3p, miR-221-5p and miR-139-3p. The most overexpressed mRNAs are ADH1C, FGF11, PGC and FBXL13. The most downexpressed mRNAs are MAL and PRR15L that both were predicted regulated by miR-196b. We assessed miRNA and mRNA signatures as potential regulators of ESCC gene expression networks such as PI3K/AKT signaling pathway signal pathways.

Our findings suggest that miRNAs play a key role in ESCC through their ability to regulate fundamental pathways such as PI3K/AKT signaling pathway. The results define miRNAs, mRNAs, and miRNA-mRNA interaction networks signatures that characterize and contribute to diagnosis of ESCC.

Cancer/Oncology

School of Medicine and Health Sciences

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Alberto Bosque-Pardos

ABSTRACT

Evaluation of HODHBt as a Modulator of NK Cell Cytotoxicity Against Cancer Cells

Signal transducer and activator of transcription (STAT) proteins are a family of transcription factors that mediate certain aspects of cellular immunity. STATs can be regulated post-transcriptionally through phosphorylation, acetylation, and SUMOylation. In the past, the lab has studied 3-Hydroxy-1,2,3-benzotriazin-4(3H)-one (HODHBt). HODHBt, a benzotriazine, blocks SUMOylation of STAT5 which increases its nuclear presence and transcriptional activity. STATs, more specifically STAT5, is an important transcription factor in the cytotoxicity of natural killer (NK) cells. NK cells are involved in an important role of immunosurveillance to recognize cancerous cells. Due to this, we wanted to understand whether HODHBt could be used as an immunomodulator to enhance the cytotoxicity of NK cells against different types of cancer. To test this, NK cells were first isolated from peripheral blood mononuclear cells (PBMCs) from healthy individuals and pretreated overnight with DMSO, HODHBt, IL-15, or HODHBt plus IL-15. The cytotoxic potential of NK cells was tested against K562 (chronic myelogenous leukemia), A2780 (ovarian carcinoma, p53 WT), AH54 (ovarian carcinoma, p53 null), OCI-Ly1 (diffuse large B-cell lymphoma- GCB type), OCI-Ly10 (diffuse large B-cell lymphoma- ABC type), and U87-MG (glioblastoma). Cytotoxicity was tested using the functional DELFIA® cell cytotoxicity assay. To do that, target (cancer) cells were labeled with an acetoxymethyl ester of BATDA. Then, target cells, after a series of washes, were incubated with effector (NK) cells at different E:T ratios for 1 hr. After incubation, supernatants were collected and mixed with a europium solution to measure the amount of target cells lysed using Time-Resolved Fluorescence. Our results indicate that HODHBt can enhance the cytotoxicity of the IL-15 activated NK cells. Interestingly, this effect was only observed in three of the six cancer cell lines. In conclusion, HODHBt has the potential to become a new immunomodulator to aid in NK cell immunotherapy tactics against different cancers or infectious diseases.

Cancer/Oncology

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Elliot Coups

ABSTRACT

Mediators of Sun Protective Behaviors for High Risk Melanoma Patients

New cases of cutaneous melanoma, a form of malignant skin cancer, are diagnosed every year. Numerous interventions have been established to help educate high risk individuals about risk factors, improve sun protection behaviors, and conduct self skin evaluations. Additionally, systematic reviews have been conducted to outline the efficacy of such interventions. These reviews, however, have not focused on the mediating variables for these studies. A mediating variable serves as a causal intermediate between an intervention and the desired outcome. To address this gap, we conducted a systematic review to determine the mediating variables affecting sun protection behaviors among high risk melanoma patients exposed to skin cancer related interventions. Identifying these variables will provide insight that will help in the design of more effective and cost efficient interventions. We hypothesized that self efficacy (an individual's belief in his/her ability to accomplish something), knowledge of skin cancer, attitudes towards skin cancer, and perceived risk of skin cancer are significant mediators. Our literature search was conducted using online databases such as CINAHL, Cochrane Database of Systematic Reviews, Embase, Google Scholar and PubMed using a variety of search terms. Additionally past reviews of similar topics were surveyed for relevant articles. Study inclusion criteria were as follows: (1) All populations were accepted with the exception of those targeting healthcare professionals; (2) An intervention (psychosocial, multimedia, mailed materials, telephone, etc) was used in each study; (3) There must be a comparison group for each intervention (separate intervention and/or a control comparison); (4) The outcome measured must seek to change a sun protection behavior (sunscreen use, tanning frequency, etc); (5) Study design must be a randomized controlled trial; (6) The study must be published in a peer reviewed journal; (7) The study period must lie between January 1, 2000 and May 31,2018; (8) A formal statistical method must be used to test for mediation of the intervention effects on one or more of the outcomes. A total of XX articles were deemed eligible for the study that will be included in the final review. Study coding was conducted to assess the quality of each article using an 11 point scale. Studies were awarded one point for each criteria that was met.

Ongoing efforts to finalize coding is underway. Upon completion of the study, the results from this review will provide insight that is relevant to the design of future interventions aimed at changing human behavior.

Cancer/Oncology

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Sally Moody, Tatiana Efimova

ABSTRACT

p38 Signaling Regulates Human Cutaneous Metastatic Melanoma (MM) Invasion and MM-Dependent Disruption of Keratinocyte Differentiation

Advancing our understanding of cutaneous MM invasion mechanisms is vital for developing new mechanism-based therapies and improving MM outcomes. Here we describe an optimized organotypic human skin equivalent co-culture system of primary epidermal keratinocytes, MM cells, and normal stromal fibroblasts recently developed in our laboratory in order to reliably model early invasive behavior of human MM as well as melanoma-keratinocyte crosstalk in the tissue microenvironment that more accurately reflects the disease pathology. p38 kinases p38alpha and p38delta are the predominant p38 isoforms in keratinocytes, while p38alpha and p38beta are the most abundant isoforms in human MM cells. However, the potential roles of p38 kinases in regulation of human cutaneous MM invasion or in control of melanoma-keratinocyte communication remain to be elucidated. Our data showed that in human skin equivalents harboring human A375 MM cells, pharmacologic inhibition of p38alpha/p38beta isoforms with specific inhibitor SB203580 led to increased invasion of A375 cells into the dermis, as manifest by significantly increased size of the dermal nests of A375 cells relative to size of those in control vehicle-treated cultures. The hyper-invasive MM phenotype observed in skin equivalents treated with SB203580 was reversed by treatment with potent pan-p38 inhibitor Compound 62 (C62) back to the levels displayed by the control cultures. These data suggest that p38alpha/p38beta function to restrict MM invasion, and support a role for keratinocyte p38delta in promoting MM invasion in this model system. Furthermore, reflecting effect of melanoma on keratinocyte differentiation as observed in human disease, skin equivalents harboring A375 MM cells displayed a marked disruption of keratinocyte differentiation program as evidenced by reduced cornification, the absence of granular layer, and severely diminished expression of differentiation markers. Pan-p38 inhibition partially restored keratinocyte differentiation, supporting a role for p38 signaling in MM-dependent loss of the latter in this system.

Cancer/Oncology

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Rong Li

ABSTRACT

Protective Effects of Topical Application of Aprepitant against Erlotinib-induced Facial Dermatitis/Hair Loss in Rats

Erlotinib, an EGFR1-tyrosine kinase inhibitor, has been used as an effective anti-tumorigenesis agent against several cancers including lung, colon, head and neck. However, significant and often severe cutaneous toxicities are serious side effects limiting its full potential use for longer survival of cancer patients. Our previous studies suggest that neurogenic inflammation plays a significant role in causing EGFR-TKI induced off-target toxicity. This study was designed to assess if topical application of aprepitant (Emend), a specific Substance P receptor inhibitor, would be protective against erlotinib-induced facial rash/hair loss, and if it is of comparable effectiveness to oral administration of the agent.

Twenty-five SD-rats (220 gm) were divided into 5 groups: 1) Control (normal diet); 2) Erlotinib alone (10 mg /kg rat weight/day) in the diet; 3) Oral aprepitant alone (Emend: 4 mg/kg/day); 4) Erlotinib+oral aprepitant; and 5) Erlotinib+topical aprepitant application (2-3 times/week on face near the nose, in between and above eyes, around the ears), and the upper back near the head and ears. Topical application was initiated 9 days after erlotinib treatment. Total area of about 4 cm2 received 28 ul aprepitant (0.75%) dissolved in transcutol:acetone:DMSO (vehicle)/cm2 via auto pipette and was equivalent to 2-3 mg aprepitant/kg rat per application. Treatment time for all groups was 12 weeks. RESULTS: Facial rash/hair loss began to develop in the Erlotinib alone group at 3-5 weeks and progressed more severely at week 8 and to a maximal extent at week 12. Dermatitis/hair loss was semi-quantified according to a numerical severity grading of 0 (none) to 4 (severe). At 12 weeks, the severity of the groups were: 1) Control: 0 ± 0; 2) Erlotinib alone: 3.16 ± 0.17; 3) Oral aprepitant alone: 0 ± 0; 4) Erlotinib+oral aprepitant: 1.17 ± 0.18; and 5) Erlotinib +topical aprepitant: 0.92 ± 0.1. Previously, we observed that oxidative indices (plasma isoprostane and neutrophil superoxide activity) were substantially elevated due to erlotinib treatment. In this study, the basal PMN superoxide activity of the erlotinib alone group was significantly ($p<0.01$) elevated 5.4-fold above controls. Oral and topical aprepitant treatment suppressed the PMN activation by 70% and 65%, respectively.

Cardiology/Cardiovascular Research

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RESEARCH MENTOR/DEPARTMENT CHAIR

Nikki Posnack

ABSTRACT

Structural Analog to Bisphenol-A Has Comparable Cardiac Effects

Bisphenol-A (BPA) is a synthetic chemical used in the production of polycarbonate plastics and epoxy resins. It can be found ubiquitously in consumer and medical products, such as food containers, water pipes, dental sealants, and electronics. Human exposure to BPA is widespread, and the chemical has been detected in 93% of urinary samples from the U.S. Additionally, intensive care and cardiac surgery patients are exposed to exceedingly high BPA concentrations through contact with plastic medical devices. The latter is concerning, given that BPA exposure has been connected with a risk of adverse cardiovascular events. As the health risk of BPA has become apparent, structural analogs are being utilized as replacement chemicals, including the fluorinated chemical, Bisphenol-AF (BPAF). Despite its use, the effects of BPAF on cardiac health are unknown. This study aimed to quantify the safety and toxicity of BPA exposure, as compared to BPAF, on cardiomyocyte electrophysiology and calcium handling. Cardiomyocytes differentiated from human-induced pluripotent stem cells (hiPSC-CMs) were treated with 10 nM - 100 uM BPA or BPAF for 5 - 60 min. Field potential duration (FPD) and contractility measurements were recorded in response to external pacing (1.5 Hz) and during spontaneous beating. Parameters of interest included beating rate, spike amplitude, FPD, and conduction velocity. Preliminary results showed that 30 uM BPA and BPAF had a significant impact on treated samples after 5 minutes. Automaticity decreased by 17% in BPA-treated samples and 16% in BPAF-treated samples, as compared with controls. FPD decreased by 15% in BPA-treated samples and 12% in BPAF-treated samples, as compared with controls. In conclusion, the results of this study provide a clearer understanding of the toxic effects of BPA and BPAF on cardiac electrical conduction. These results align with our unpublished data on Langendorff-perfused whole hearts, which suggest that bisphenol chemicals may impair cardiac electrophysiology through disruption of Ca2+ channels. Screening in hiPSC-CMs revealed that replacement products, such as BPAF, could be similarly damaging to cardiac function in a dose-dependent manner. Additional studies are necessary to investigate the intercellular mechanisms of bisphenol toxicity and to inform more translational techniques.

Cardiology/Cardiovascular Research

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Joe Krepp

ABSTRACT

Transcatheter Mitral Valve Thrombosis: A Case Report and Literature Review

Trans-catheter mitral valve replacement (TMVR) is an exciting alternative therapy for complex patients with mitral valve disease. The experience with TMVR is new and there is a lot yet to discover about their durability, long-term outcomes, and complications including, mitral transcatheter heart valve (THV) thrombosis. Many factors have been speculated to be associated with the increased risk of THV thrombosis. Here, we report a case of mitral THV thrombosis then discuss published data on the subject.

A 72-year-old woman who underwent TMVR for severe mitral regurgitation with mitral annular calcification. She was discharged on aspirin and clopidogrel for thromboprophylaxis. She presented after 30 days with symptomatic heart failure. Her transesophageal echocardiogram showed increased mean trans-mitral gradient with severe subvalvular thickening with immobile neo-anterior leaflet. She was subsequently started on a heparin drip with bridge to warfarin with international normalized ratio goal of 2.5 to 3.5.

Since most patients undergoing TMVR are within a high-risk population, caution should be implemented to minimize complications, valve dysfunction, and failure. We reviewed 42 TMVR papers with total of 1484 patients including 60 with mitral THV thrombosis. We discussed the most common strategies used for mitral THV thromboprophylaxis and treatment.

Given current evidence, post-TMVR anticoagulation should be considered for at least 3 months, especially in those without significant bleeding risk. Longer anti-coagulation therapy should be considered for patients with multiple risk factors for thrombus formation. Additionally, systematic active screening with close clinical follow up help promptly identify those with subclinical THV thrombosis or need longer anti-coagulation therapy.

Cardiology/Cardiovascular Research

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

P. Sheena Khurana

ABSTRACT

Comparison of Average and Lowest Home and Office Blood Pressure Recordings and Implications on the Management of Chronic Hypertension

Hypertension is a major modifiable risk factor for cardiovascular disease and premature mortality in the US. Studies suggest that elevated home blood pressures (BPs) are associated with cardiovascular events, stroke, and mortality.2 The Systolic BP Intervention Trial (SPRINT) demonstrated that lower target BP, less than 120/80, resulted in lower rates of fatal and nonfatal cardiovascular events and death.3 Subsequently, the American Heart Association & American College of Cardiology (AHA/ACC) altered their guidelines to adopt this as the new target. However, SPRINT specified 5 minutes of quiet rest followed by 3 measurements without an observer present; a method is not routinely used in practice. Another study found that BP measurements taken using the SPRINT method were significantly lower than routine BPs and that end organ damage had a stronger relationship with the SPRINT method.4 The ACC/AHA guidelines instruct providers to take the average of at least two BP recordings.5 This is based on expert opinion and there is no literature to support this. We sought to understand if the average BP recording is significantly different from the lowest BP recording in the home and office settings.

We enrolled 18 patients with hypertension to collect 3 home BP recordings in the morning and 3 home BP recordings in the evening for 7 days. We also collected 2 office BPs. We utilized the 2-tailed paired t-tests to determine the differences between BP recordings. Mean home systolic blood pressure (SBP) was 131.9 mm Hg, mean office SBP was 136.8 mm Hg, this difference was not significant (p=.29). The difference between mean diastolic blood pressure (DBP) in both settings, 1.1 mmHg, was also not significant. However, the minimum office SBP and minimum office DBP were significantly higher than the minimum home recordings, 19 mmHg SBP (p=.003) and 9 mmHg DBP (p=.015) higher. In both settings there was a significant difference between mean and minimum readings: mean home BP was 21/13 mmHg (p<.0001) higher than the minimum home BP and the mean office BP was 7/2 mmHg (p=.01 SBP, p=.011, DBP) higher than the minimum office BP.

We found that minimum BP is significantly lower than mean BP in both settings. This may indicate that the minimum BP is likely the true BP, which could correlate with cardiovascular outcomes more closely than the average BP. Therefore, we may be overtreating patients by using the SPRINT target BP, but not adopting their measurement technique in the clinic.

Cardiology/Cardiovascular Research

School of Medicine and Health Sciences

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David Scalzitti

ABSTRACT

In Teenagers Who Smoke Cigarettes Are Nicotine Patches as Compared to Placebo Effective to Decrease the Number of Cigarettes Smoked? – A Systematic Review

In the United States of America (USA), "70% of teenage deaths are attributed to significance health-risk behaviors, which is referred to as the contributing factors that increase the causes of morbidity and mortality among teenagers and adults, in the USA" (Kann, et al., 2014), tobacco use is identified as one of these factors by the "Youth Risk Behavior Surveillance System"-YRBSS (CDC, 2017). YRBSS 2013 data reported that "15.7% of high school students had smoked cigarettes and 8.8% had used smokeless tobacco" (Kann, et al., 2014, para. 3). The study was mostly interested in studies comparing nicotine patch therapy to other forms of treatment to better understand its strength in wide-ranging cigarette smoking approaches.

The aim was to examine whether nicotine patch was more effective in encouraging abstinence from cigarettes smoking compared to placebo.

Systematic reviews and meta-analyses of randomized controlled trials involving the general teenage age group smokers who were current smokers-"smoked less than 100 cigarettes over their lifetime and smoked at the time of the interview. Databases were searched for relevant studies reported in English that employed a randomized design published since 2000. Two authors extracted data and assessed quality. The primary outcomes and prioritization were continuous abstinence at 3, 6 and 12-month follow-up or more for the number of patients who responded to treatment, defined as a reduction/abstinence. Heterogeneity between studies did not preclude combined analyses of the data.

4 of 266 publications were included. Four studies reported positive effects on smoking cessation at end of treatment: (1) nicotine patches improved continuous abstinence at 6 weeks – 9 weeks months; (2) nicotine patch improved continuous abstinence at 3 to 6 months; (3) nicotine patches improved continuous abstinence 6 and 12 months; (4) nicotine patches improved continuous abstinence at 6 months – 12 and 24 months (5). All studies showed, continuous abstinence at follow up differed in percentage between groups both at 6 weeks through 24 months, with NRT (Nicotine patch) intervention groups achieving higher rates in most of the studies compared to placebo intervention group.

NRT intervention methods seem to increase smoking abstinence in those treated for smoking cessation. Further and larger sample size studies are required to make stronger the base of evidence.

Cardiology/Cardiovascular Research

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Joseph Krepp

ABSTRACT

Cardiovascular Outcomes in Patients with Mitochondrial Disease in the United States: A Propensity Score Analysis

Mitochondrial disease (MD) refers to a group of clinically heterogeneous disorders that result from dysfunctional oxidative phosphorylation and subsequent cellular incapability to meet energy demands. Since 90% of the energy requirement of the heart depends on mitochondrial oxidative metabolism, cardiovascular morbidity and mortality are hypothesized to be prominent in mitochondrial disease. However, with an estimated prevalence of 1 in 5000 people, previous studies have been limited by the rare nature of MD. This study aimed to explore the relationship between MD and cardiovascular outcomes.

The 2016 National Inpatient Sample (NIS), which includes data from over 7 million subjects, was used for this study. Baseline demographics and clinical characteristics were compared between patients with MD (ICD9/10 codes 277.87/E88.4) versus patients without MD. Propensity scores were estimated from baseline patient characteristics and used to assemble a matched cohort to examine the impact of MD on major adverse cardiac events (MACE), including all-cause in-hospital mortality, cardiac arrest, and acute congestive heart failure (both systolic and diastolic).

In total, 705 patients were identified with a diagnosis of MD. The mean age was 22 +/- 21 years with slightly more females (54%) than males and 67% Caucasian patients. MD, when compared to their matched cohort without MD, is associated with 2.4-fold increased odds of MACE (OR 2.42; 95% CI 1.29-4.57; p = 0.005) and more than doubled odds of acute systolic heart failure (OR 2.37; 95% CI 1.08-5.22; p = 0.027). In addition, MD is associated with 14-fold increased odds of all-cause in-hospital mortality (OR 14.22; 95% CI 1.87-108.50; p = 0.008) while there were no statistically significant differences in cardiac arrest and diastolic heart failure between the groups.

Mitochondrial disease is associated with a significantly increased risk of inpatient MACE. In particular, MD is strongly associated with acute systolic heart failure and in-hospital mortality.

Cardiology/Cardiovascular Research

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

David Yamane

ABSTRACT

Endotoxin Activity in Adult ECMO Patients

The use of extracorporeal membrane oxygenation (ECMO) has increased over the past 30 years and only continues to grow. To optimize ECMO it is imperative to understand the physiologic changes it causes. Previous studies in elective ECMO and cardiac surgery patients have noted elevations of cytokines and endotoxin activity (EAA) after initiation of ECMO. This suggests that ECMO incites an inflammatory response and may also affect the intestinal epithelial barrier leading to endotoxemia. The aim of this trial was to determine the effect ECMO had on serum EAA levels in subjects undergoing urgent or emergent ECMO therapy.

Subjects were adult patients cannulated for ECMO at George Washington University Hospital between June 1, 2018 and July 31, 2019. Demographics and APACHE II scores were collected. Three EAA samples were measured at intervals including prior to cannulation, between 1-6 hours after cannulation, and at 72-120 hours after cannulation and are referred to as samples 1, 2, and 3 respectively. EAA levels less than 0.2 are considered negative, 0.2-0.6 intermediate, and 0.6 or greater is high activity. Statistical analysis was performed using a sign rank test.

Thirteen subjects were enrolled. One subject was excluded due to an irreconcilable error in testing. Eleven subjects had 3 samples drawn while 1 subject did not have sample 3 drawn. Average (std) age was 45.8 (15.6) years and 10 were male. Mean (std) APACHE II score was 20.3 (8.3). Three subjects were veno-venous ECMO, 7 were veno-arterial ECMO, and 1 was cannulated as an RVAD. Seven subjects survived and 5 died. One subject had a negative EAA prior to cannulation. Median (IQR) sample 1 EAA was 0.56 (0.40, 0.70), sample 2 EAA 0.51 (0.36, 0.69), and sample 3 EAA 0.46 (0.40, 0.56). Sample 2 and sample 3 were compared to sample 1 and while a decrease across time was found, this decrease was not statistically significant. The largest decrease in a subject was 0.42 and the largest increase was 0.19. There was also no statistical difference in EAA amongst those who survived and those who died.

Previous studies have shown an increase in EAA and cytokines after initiation of ECMO in elective cases. This trial showed that urgent and emergent ECMO cannulation did not statistically affect EAA levels across time.

Clinical Specialties

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RESEARCH MENTOR/DEPARTMENT CHAIR

Deepika Darbari

ABSTRACT

Integrative Services and Outcomes for Patients with Sickle Cell Disease

In 2018, the Integrative Sickle Cell Pain Clinic was launched at Children's National Hospital. The Integrative Sickle Cell Pain Clinic is a multidisciplinary clinic staffed by physicians and providers from the divisions of anesthesiology, palliative care, and hematology. We provide a hematology visit, acupuncture, pain management, psychotherapy and counseling, physical therapy, aromatherapy, and healing touch. These services are also offered to the patients during an admission for pain or by referral from their primary hematologist. The primary goal of the study was to explore the experience and satisfaction of patients/parents who have received integrative therapies for pain associated with SCD.

This study was approved by our Institutional Review Board. Patients who struggle with acute and chronic pain were identified by their providers and other members of the Sickle Cell care team and were referred to the Integrative Pain Clinic. Patients seen in the integrative clinic were approached to participate in this study using questionnaires to evaluate their experience before and after alternative therapies. Written informed consent was obtained for study.

Over the past year, 37 patients have been seen in our Sickle Cell Integrative Pain Clinic. Thirty-one patients who attended this clinic consented to participate in the study and completed surveys. Patients seen in clinic ranged in age from 11-22 (M age = 15) and 80% were female. The genotypes of patients followed in clinic are as follows: 73% with HbSS, 38.5% with HbSC, and two with HbSβ⁰. Most patient (74%) are currently taking hydroxyurea, and 77% of the patients are taking opioids (short or long acting). Twenty-five patients completed a treatment satisfaction survey after their clinic visit. A majority of patients (72%) agree that integrative therapies are an acceptable way of treating adolescents' pain and believe that it is likely to be an effective treatment for sickle cell pain. The vast majority (88%) of patients reported having a positive experience with the therapies. Since being seen in the integrative clinic, 18 patients (58%) were hospitalized at a later date due to pain and 9 (50%) of those patients received integrative services during their hospitalization. In this study, we demonstrate that patients who attend our integrative clinic find these methods an acceptable and effective way to treat their sickle cell pain, and they report an overall positive experience. These therapeutic options should be continued to be offered and further explored in this vulnerable population.

Clinical Specialties

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Jonathan Sherman

ABSTRACT

Cyberknife Radiosurgery Treatment Of Trigeminal Neuralgia: A Single Institution Examination With Long Term Follow-Up

During the past decades, framebased stereotactic radiosurgery has proved its efficacy and safety as therapy for Trigeminal Neuralgia (TN). However, few studies exist using non-framebased radiosurgery devices such as CyberKnife (CK), especially studies that report long-term follow-up.

From 2010 to 2019, 38 patients were treated for trigeminal neuralgia at our institution. A retrospective chart-review of these patients was performed in order to collate predefined variables, which was followed by a prospectively collected follow-up phone survey to collect most recent health data. CK outcome was measured using the Barrow Neurological Institute (BNI) scores for pain and hypoesthesia, which was statistically evaluated by multivariate analyses.

Continued success at most recent follow-up was reported in 81.3% of patients (mean follow-up 37.1 months). The median pretreatment BNI pain score was V and the median BNI pain score at most recent follow-up was IIIa, indicating an improved quality of life. Trigeminal pain recurred in 18.8% of patients (range: 1.3 - 2.0 years). New-onset bothersome hypoesthesia was reported in 68.6% of patients. Increased CK success correlated with increased BNI hypoesthesia scores (p=.001) as well as with dysphagia and paresthesia. (p=.003). Additionally, increased CK success correlated with idiopathic pathogenesis of TN pain in comparison to TN pain derived from stroke/tumor/surgery (p=.034). Interestingly, CK success did not correlate with typical nor atypical TN classification.

CK stereotactic radiosurgery is an effective long-term therapy for treating TN, however, patients should be aware that side effects can occur which correlate with an effective treatment. Furthermore, TN pathogeneses should be taken into account to be used as a possible predictor of success during CK treatment planning. We look to perform multicenter prospective study in the near future to validate these results.

Clinical Specialties

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Kenneth Nelson

ABSTRACT

Readiness Relevance of Society of Military Orthopaedic Surgeons (SOMOS) Annual Meeting Topics: A 10-Year Review

The Annual Meeting for the Society of Military Orthopaedic Surgeons (SOMOS) provides a forum in which to share and collaborate on military orthopaedic topics. Due to funding constraints and fiscal austerity, financial support for SOMOS attendance has been threatened. Recently, the Department of Defense (DOD) has placed increased focus on optimizing military readiness, a term with varying interpretations. The purpose of this study was to determine how much "readiness" value the SOMOS Annual Meeting contributes to military orthopaedic surgeons and the service members they care for.

The titles of all invited oral presentations for the main scientific sessions were extracted from each SOMOS Annual Meeting program agenda from 2009 to 2018. Rapid fire presentations were not included. Two orthopaedic surgeons independently determined the readiness relevance of each presentation based on their titles. Three categories of military readiness relevance were defined and used: Medically Ready Force (service member readiness); Ready Medical Force (surgeon readiness); and neither. Data were reported in counts and frequencies, both overall and by year to identify potential trends.

There were a total of 1,196 oral presentations over the 10 SOMOS Annual Meetings included. Of those, 20.9% (range: 6.6%-31.3%) pertained to the military readiness of surgeons and 43.2% (range: 32.1%-52.6%) pertained to the military readiness of service members, resulting in a total of 63.9% (range: 56.3%-77.9%) of all presentations with military readiness relevance. There were no obvious trends in density of readiness topics over time.

For the last decade of SOMOS Annual Meetings, topics of military readiness for both surgeons and service members have accounted for more than half the presentations given. This study demonstrates the value of the SOMOS Annual Meeting with regard to preparing surgeons and service members for the operational setting and deployment downrange. These findings may be used to by leadership to justify funding support for SOMOS and guide decision-making for future meetings.

Clinical Specialties

School of Medicine and Health Sciences

PRIMARY PRESENTER

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Julia Finkel

ABSTRACT

Assessing Ketorolac Analgesic Effect in Postoperative Pectus Excavatum and Pectus Carinatum Patients: An Observational Study

An objective assessment of pain and analgesic efficacy is an unmet need. While the standard of care for pain is the Visual Analog Score, this method is subjective and does not guide use of a specific intervention. In order for pain management to improve, it is essential that there is an objective measure for the processes underlying pain transmission. This observational study evaluated the analgesic effect of Ketorolac in postoperative pectus excavatum and pectus carinatum patients utilizing a novel method employing pupillary reflex dilation.

An observational pre/post dose study measured the change in neurostimulus-evoked pupillary reflex dilation (nPRD) in postoperative pectus excavatum and pectus carinatum patients at Children's National Medical Center (N=10, 10 male, 15-19 yrs) who received 30 mg intravenous Ketorolac as part of their care. Measurements occurred in triplicate at baseline and approximately one hour following Ketorolac administration. An electrical stimulus elicited pupillary reflex dilation at 2000, 250, and 5 Hz for the A-beta, A-delta, and C-fibers, respectively. The perception threshold was determined at baseline and used throughout observation. The main outcome variables measured were area under the curve (AUC) for each nPRD, amplitudes of the curve, and pain scores. Paired t-tests were used to compare amplitudes and AUCs before and after Ketorolac for each fiber type. There was no statistically significant change in amplitude following Ketorolac for any of the fiber types. Within pectus excavatum patients (N=9), the effect of Ketorolac on C-fiber nociception assessed using the AUC was trending towards significance ($p=0.075$), while there was no statistically significant effect on AUC of A-delta or A-beta fibers. Because a prototype device was used, analyses were also completed using the clearest reading. Ketorolac had statistically significant effects on the AUC of the C-fiber ($p<0.05$), effects trending toward significance on the AUC of the A-delta fiber, and no effect on the A-beta AUC. There was no correlation between changes in pain score compared to changes in AUC or amplitude.

The data from this study support the use of this technology to determine analgesic impact on nociception. Primary analyses suggest that Ketorolac affected nociception in the A-delta and C-fiber in post-surgical patients. Assessing the absolute effect of Ketorolac is difficult given that postoperative patients receive polypharmacy as part of their standard care. Given the difficulty of objectively assessing pain, future study into analgesic effect should utilize this method to classify the fiber-specific effect of analgesics.

Clinical Specialties

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

David Yamane

ABSTRACT

How Well Do Emergency Medicine Providers Manage Initial Ventilator Settings?

Emergency Medicine (EM) providers are responsible for choosing initial ventilator settings for newly intubated patients in the emergency department (ED) with very little information. It is unclear how often these initial ventilator settings are adjusted by intensive care unit (ICU) providers. We sought to examine whether the initial ED ventilator setting differed from those upon admission to the ICU. Patient outcomes (ICU days, ventilator days, hospital days, and death) were assessed to observe the effect of changing the ventilator settings.

We conducted a retrospective study from January 2016 to December 2018 of intubated patients in the ED. We extracted patient demographics, lab values, height, weight, and ventilator settings in both the ED and ICU. We calculated ideal body weight (IBW) for all patients to determine the tidal volume (TV) per kilogram given in the ED and ICU. We recorded several outcomes including: ventilator days, ICU days, hospital days, and death. Spearman's correlation coefficient, ρ, was used to identify the monotonic correlation between ventilator modification and outcomes of interest.

Ventilator settings were not changed for 127 of 217 patients (58.5%) between the ED and the ICU. In the 90 patients whose settings were modified, 33 (36.7%) TV were lowered when transferred to the ICU. Of the 33 patients who had their TV decreased, only 8 patients crossed the 8 mL/kg threshold considered a standard TV. The TV delivered to the other 57 patients (63.3%) was increased by ICU providers. Of these 57 patients, 15 had the TV cross above the 8 mL/kg threshold. Monotonic correlations via Spearman's ρ showed no significant effect of the magnitude of TV modification on mortality ($\rho=0.0543$, $P=0.4261$), days on ventilator ($\rho=0.0202$, $P=0.7679$), days in ICU ($\rho=-0.0327$, $P=0.6315$), or days in hospital ($\rho=-0.0817$, $P=0.2305$).

Admitting ICU providers changed the ventilator settings of less than half of intubated patients in the ED, suggesting that most of the time, the initial ventilator settings set by EM providers are deemed appropriate by ICU providers. When observing the relationship between the TV modifications and patient outcomes, no adjustment of TV positively affected patient outcomes.

Clinical Specialties

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Ali Pourmand

ABSTRACT

The Epidemiology of Ocular Emergencies in the Maritime Environment

There is little literature on the epidemiology and management of injury and illness at sea, an environment which is remote from definitive care and defined by limited on-site medical resources. Worldwide there are tens of thousands of ships engaged in shipping, fishing, construction, pleasure cruising, and other activities. Threats to sight carry a significant personal and economic cost. We sought to characterize ocular illness and injury on commercial vessels.

This is a retrospective chart review of adult patients presenting with ocular illness or injury onboard ships that receive telemedical care from our practice. Chart data from October 2018 through September 2019 were reviewed. Charts were abstracted by emergency physicians who collected data regarding demographics, type of ocular pathology, mechanism of injury, and patient management.

We reviewed 803 patient encounters, of which 31 (3.8%) were for ocular complaints. 32.3% of these were for traumatic injury or occupational exposure, including blunt trauma, foreign body, chemical exposure, and electrical arc exposure. Eye protection was worn in 10% of traumas, eye protection was not used in 10% of traumas, and in 80 % of traumas, eye protection status was unknown or not documented. The most common diagnoses among the 21 non-traumatic cases were conjunctivitis (n=5), hordeolum (n=4), and chalazion (n=2). Definitive diagnoses could not be made via telemedical consultation in 47.6 % of non-traumatic cases, however, sight-threatening diagnoses including vitreous hemorrhage (n=2), retinal detachment (n=1), and central retinal artery occlusion (n=1) were suspected in 19% of non-traumatic cases. Vessels at sea had an average time-to-port of 6.8 days (Range 2-30 days). 3 of 31 patients required evacuation or ship diversion. Compared to non-traumatic illness, traumatic injuries were more likely to require in-port specialty consultation (70% vs 28.6%).

The majority of ocular illnesses and injuries can be managed onboard without diversion or evacuation. Traumatic injuries are more likely to require on-shore specialty evaluation than medical illnesses. More research is needed on injury reduction to limit costly ship diversion, patient evacuation, and on-shore evaluation.

Clinical Specialties

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Ali Pourmand

ABSTRACT

Characteristics of Patients Treated in ED "Hallway Beds"

To maintain patient flow despite emergency department (ED) crowding, many hospitals place patients in spaces not originally designed for the initial evaluation of patients ("hallway bed"). Such spaces have a variable degree of privacy and often lack call bells, oxygen, suction, or monitors.   Little is known about how the use of hallway beds affects the quality of care, patient satisfaction, and patient safety. We sought to describe the profile of patients whose evaluation was initiated in ED "hallway beds".

A retrospective chart review was conducted in a single, urban, academic ED between June 2018 and June 2019. Inclusion criteria included all patients presenting to ED whose bed assignment was a "hallway bed". We examined patient's demographic characteristics (including insurance status, race, and ethnicity), mean LOS, mode of ED arrival, emergency severity index(ESI), and disposition.

During the study period, the ED had 80,000 total registrations. A total of 13,100 patients (16.5%) had their ED evaluation initiated in a hallway bed. The mean (SD) age of patients was 46 (17) years, and 54% were male. ESI 2 (emergent) were 44%, ESI 3 (urgent) 45%, ESI 4 (less urgent) 8.9 %, ESI 5 (non urgent) 1%. 45 % of patients arrived by ambulance. The most common chief complaints were ethanol intoxication (8.5%), altered mental status (3.5%), abdominal pain (3%), chest pain (2.6%), and fall (2.1%). 62% were black or African American, and 21% Caucasian. The mean (SD) total ED LOS was 7.29 (4.47) hours. 75 % of patients were discharged home, 12.4% were admitted as inpatient, and 1.8 % admitted to observation status. The total order of computed tomography scan was 6,569 and x-ray was 8,955.

The use of "hallway beds" for patients with serious illnesses was frequent in our ED and a direct result of the "boarding crisis". It is our belief that this practice is widespread and is often unacknowledged by the hospital's administration and regulatory agencies. Further inquiry into how "hallway beds" can be optimally utilized could benefit patient care periods of high ED crowding.

Clinical Specialties

School of Medicine and Health Sciences

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Ali Pourmand

ABSTRACT

An Analysis of Patients Presenting to the Emergency Department with Acute Stroke

Acute ischemic stroke is time-sensitive with earlier treatment and interventions resulting in more favorable outcomes. Rapid triage in the field and clinical and diagnostic evaluation in the emergency department (ED) are paramount and the approach to management may vary depending on timing of presentation. Our objective was to describe patient characteristics, pattern of ED arrival, and ED resource utilization among patients with stroke.

A retrospective chart review was conducted in a single, urban, academic ED with annual ED visits of 75000, between September 2009 and September 2019, examining adult patients with ischemic stroke. Within this patient population, we evaluated demographic characteristics, arrival time, last known well to ED arrival time, mode of transport, initial NIHSS, and door to tPA administration. Chi-square and analysis of variance or the Kruskal-Wallis test were used to examine associations.

We identified 2872 cases of ischemic stroke. The mean age was 64 ± 14years and 52% of cases were male. Time of arrival was significantly associated with diagnosis (p<0.0001). Patients with ischemic stroke had more variability in their time of arrival, peaking between 09:00 AM and 19:00, with the nadir between midnight and 0700. Among patients with ischemic stroke, 781 (27%) arrived by private vehicle. Advance notice by emergency medical services (EMS) was provided in 49% of patients with ischemic stroke. The mean NIHSS score was 7.1 ± 7.1. 415 (14%) received tPA. Those who arrived by EMS were significantly more likely to receive tPA (18%) than those who arrived by private car (6%)(p<.0001). Receiving tPA was significantly associated with arrival time (p<.0001). The arrival hours when ischemic stroke patients were most likely to receive tPA were 16:00 and 21:00 (16%), 15:00, 09:00 and 03:00 (15%), and 07:00, 10:00, and 20:00 (14%). Hours when patients were least likely to receive tPA were 02:00 and 06:00 (3%), 01:00, 04:00 and 05:00 (4%).

Time of day and mode of arrival appear to influence treatment with intravenous tPA. Over one-fourth of ischemic stroke patients arrived in the ED by private transportation and half of the patients transported by EMS to the ED did not have a prehospital advanced notification. Identifying ways to best educate patients and EMS personnel on stroke presentation and the importance of advance notification and prompt arrival remains important.

Clinical Specialties

School of Medicine and Health Sciences

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David Yamane

ABSTRACT

Mortality of Hepatic Air on Point of Care Ultrasound in Cardiac Arrest: Does Location Matter?

Given the high mortality in patients with cardiac arrest, previous research has sought to determine factors that distinguish patients who are likely to have return of spontaneous circulation (ROSC) from those in whom continued resuscitation is futile. Prior research utilizing multiple imaging modalities has suggested an association of hepatic venous air with mortality. As point of care ultrasound (POCUS) is already becoming more frequently used in the context of resuscitation, we sought to evaluate if the presence of any hepatic air, parenchymal or venous, on POCUS had a similar mortality association.

We completed a retrospective review of patients who experienced non-traumatic cardiac arrest and had POCUS with adequate views of the hepatic parenchyma. The majority of these images were sub-xiphoid evaluations of cardiac activity, with incidental capture of the liver. Archived ultrasound images were independently reviewed to determine the presence of hepatic parenchymal and/or hepatic venous air. Electronic medical records were then reviewed to collect other clinical data, including admission rate to ICU and overall hospital mortality.

From January 1, 2017 through June 16, 2019, 87 patients met inclusion criteria, including 6 IHCA and 81 OHCA. Ultimately, 68 (78.2%) died and 19 (21.8%) survived. Of those who died, 40 (58.8%) had hepatic air, while 28 (41.2%) had none. Of those who died with hepatic air, 38 (95%) demonstrated parenchymal air, while 27 (67.5%) demonstrated venous air. Of the survivors, 9 (47.4%) had hepatic air, while 10 (52.6%) had none. Only a single survivor demonstrated hepatic venous air (11%). While the difference in mortality with respect to presence of undifferentiated hepatic air was not significant (p=0.37), there was a significant difference with respect to the presence of venous air (p=0.0046).

Our study demonstrated that the incidence of post-arrest hepatic air on POCUS was common, although the presence of air in parenchyma alone did not significantly distinguish patients with respect to mortality. Hepatic venous air, however, may be of prognostic value. Further studies are necessary to better describe this phenomenon.

Clinical Specialties

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Patricia Latham

ABSTRACT

Acquired Hemophagocytic Lymphohistiocytosis: An Easily Missed Cause of Death in ICU Patients.

Hemophagocytic Lymphohistiocytosis (HLH) is an inherited or acquired hyperinflammatory disorder with aberrant activation and accumulation of activated histiocytes and cytotoxic T cells, with a mortality rate of 20-80%. Clinical criteria are established for diagnosis; however, HLH has been reported in up to 60% of patients with severe sepsis who do not meet diagnostic criteria. The diagnosis of HLH and prompt directed therapy is necessary for best prognosis; yet, it is likely that cases are missed in the ICU setting. HLH has been found in up to one third of ICU patients, suggesting it is more common in this setting than previously reported.

Diagnosis of HLH at autopsy in ICU patients can help to establish the true prevalence of the diagnosis in these patients, but reports of autopsy findings in ICU patients with known HLH are limited. In order to increase recognition of the pathology of HLH at autopsy in this setting, we present here a case report describing the autopsy findings of an ICU patient who died with sepsis and a confirmed HLH diagnosis.

A 60-year-old male was diagnosed with secondary HLH and treated with etoposide and dexamethasone. Shortly after completing chemotherapy, he became acutely ill with unstable blood pressure, tachycardia, fevers, ferritin of >110,000 ng/mL, and pancytopenia. He developed signs of multiorgan falure and blood cultures were positive for E.Coli. The patient was transferred to GWU Hospital for further care, including continuation of dexamethasone and etoposide for HLH. Despite treatment, the patient developed septic shock in the setting of severe neutropenia and expired.

At autopsy, the patient showed a diffuse erythematous rash in the upper body, which can be seen in HLH, as well as widespread lymphadenopathy and hepatospleomegaly, with petechial hemorrhages in liver, spleen lymph nodes and lungs. The bone marrow was markedly hypocellular, with an increase in macrophages and frank erythrophagocytosis. The liver showed focal infarcts with necrosis, increased sinusoidal macrophages and frequent erythrophagocytosis. The lymph nodes showed marked sinusoidal dilatation with activated macrophages, hemorrhage and erythrophagocytosis.

Marked erythrophagocytosis in multiple organs at autopsy is characteristic of HLH and can help in the diagnosis, especially in patients with complicating sepsis and shock in whom the diagnosis is not made prior to death. Identifying these cases at autopsy may help to understand the prevalence of HLH in the ICU setting and increase the potential for the diagnosis and proper treatment in this setting.

Creative Arts

Columbian College of Arts and Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Jordan Potash

ABSTRACT

An Art Therapy Workshop for Fostering Teacher Empathy: Program Evaluation

A considerable number of teachers are expected to deal with student crises on a daily basis and partake in behavioral interventions multiple times a day. These teacher-student interactions are often handled on a superficial level without the internal reflection of either individuals' experience.

In a 60-minute professional workshop, this study aimed to evaluate empathy in schoolteachers through art making to understand the adverse child experience of students in crisis. Using a qualitative design, the study explored the perspectives of twelve elementary school teachers. Participants engaged in art making aimed to address a difficult experience within the student-teacher relationship that was hard to navigate, which provided the opportunity to look at the situation from an outsider perspective. Participants free associated and wrote what they noticed about each perspective through self-reflection.

Even though some teachers expressed confidence in their responses towards students in crisis because such situations happen frequently, the most significant themes in the participants' experiences reflected the insecurities about their own competence to effectively support a student in crisis such as (1) attunement, (2) context, (3) implicit bias, and (4) self-efficacy.

The findings suggest a need for teachers to be trauma-informed, skillfully trained, and continuously practicing cultural humility so they can understand their reactions in response to student experiences. Art therapy can provide the opportunity for moments of reflection to gain new perspectives and remain objective in the subjective experience.

Creative Arts

Columbian College of Arts and Sciences

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Jordan Potash

ABSTRACT

Art Therapy with Survivors of Intimate Partner Violence in Russia: Participatory Action Research

Intimate partner violence (IPV) in Russia is often addressed by traditional mental health treatments. As an alternative, community-based art therapy has the potential to bolster resilience and advance human rights for women who survived IPV. Since art therapy as a profession is still in development in Russia, a socioecological framework that considers the sociopolitical context is warranted. The goal of this investigation was to offer an opportunity for IPV survivors to communicate their stories through creative processes, while also identifying features of art therapy that can contribute to cultural transformation through community practice.

Participatory action research (PAR) method holds a unique communal and personal empowerment tool for applying creative arts therapy in gender-oppressed communities. In collaboration with Awareness Will Stop Gender Violence, Russia-based nongovernmental organization, I (art therapy student) facilitated a one-time culturally informed workshop that incorporated elements of art, movement, and music in order to allow participants to share their personal stories.

The participants shared stories that demonstrated isolation, uncertainty, and lack of control that resulted both from personal trauma and socio-political influences in Russia. Participant self-reports and facilitator observation noticed positive shifts in participants' emotional state. Thematic analysis revealed several features of art therapy that promoted this change: 1) sense of freedom and autonomy; 2) self-awareness; 3) attunement (connection); and 4) self-regulation.

The findings outline how art therapy integrated with PAR can enable agency and empowerment to survivors of gender violence in Russia. Art therapy may serve as a reflective tool in order to improve self-understanding and reframe way of thinking. These personal experiences have the potential to reach beyond personal expression in order to raise awareness in society and challenge male domination that perpetuates IPV.

Creative Arts

Columbian College of Arts and Sciences

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Dana Tai Soon Burgess

ABSTRACT

The Chesapeake Bay: An Examination of Dead Zones

The Chesapeake Bay is the largest estuary in the United States. It feeds into the Atlantic Ocean and reaches six states as well as Washington, DC. Two of the five major shipping ports for the North Atlantic are located along the Chesapeake: Baltimore, Maryland and Hampton Roads, Virginia. With nearly 4,000 species of plants and animals calling the Bay home including fish, shellfish, birds, and grasses, the estuary is responsible for producing hundreds of millions of seafood per year. The most popular seafood that can be found along the waterway includes oysters, blue crabs, striped bass, and other popular fish species. Many plants and animals depend on the vast ecology of the Bay for their habitat and survival.

Stormwater runoff from farms, residential areas, and streets along the Bay add various pollutants into the way such as nitrogen, phosphorous, and sediments. While nutrients are essential for the health of large waterways such as the Chesapeake, too many can contradict the water quality. The various mixture of pollutants can result in dead zones, or areas of hypoxia. Algae blooms are a common factor of these dead zones and can suffocate marine life, creating a biological desert. Although these zones are a natural phenomenon, scientists believe human activity has increased the presence and severity of these zones, globally. Unknown uses of pesticides and herbicides from lawns and farms, and sediments from roads runoff into the waterway, displacing the natural chemical composition. This study examined the current state of the Chesapeake Bay and conjoined environmental data and research with creative movement.

In order to do this, a research and movement study took place in Washington, DC and Annapolis, Maryland over the course of one year. Through informational interviews with a scientist at the Chesapeake Bay Foundation, scholarly research, and movement experiments, a 12-15 minute dance piece will be a result based on the findings from examining the Bay's dead zones. The piece will be included in the Corcoran School of the Arts and Design's NEXT Honors Thesis Performances, specifically on April 16-18, 2020. The piece will marry environmental studies and creative movement, showcasing scientific research and how dance can inform audiences on environmental topics as well as issues.

Creative Arts

Corcoran School of the Arts & Design

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Erin Speck

ABSTRACT

Design for Sustainability and Human Wellbeing

Today more than ever, sustainability is a common and increasingly important component of design education. In the built environment field, several organizations define sustainability standards and award certifications to exceptional socially and environmentally responsible projects.

Throughout this study, the goal was to compare the standards set by major international organizations: Green Globes, BREEAM, Living Building Challenge, the International WELL Building Institute, and LEED. Students familiarized themselves with the structure of each certification, identified commonalities in their standards and requirements, and sought out evidence of these practices in Washington, D.C. and in several neighborhoods in Barcelona, Spain. Small groups explored El Born, Las Ramblas, and Barcelonetta, while photographing traditional and modern sustainable lifestyle practices. Students explored neighborhood markets, learned about the unique recycling system, and noted urban planning practices that place unsightly, polluting infrastructure beneath the city. They then compiled this evidence and more, and applied the appropriate certification categories to each practice. The categories related to: transportation, water efficiency, energy conservation, construction resources, land use, indoor environment, waste, and innovation.

We found that many of the certifications had standards in common. Some, like WELL and Living Building Challenge, focused more on the human experience than the built environment, with categories focusing on beauty, health and wellbeing, and nourishment, but overall, the organizations we studied gave value to similar aspects of sustainability. Many of these practices are evident in Barcelonian neighborhoods, both in commercial and private residential areas. Students took notice of sustainable strategies that were part of a conscious effort to reduce environmental impact, and achieve acknowledgement, as well as those that were ingrained in the socially and environmentally responsible culture in Barcelona. Many of the practices documented fall into that second category, starting an interesting discussion about how cultural differences between the U.S. and Spain affect our relationship to sustainability.

Drug Abuse

Milken Institute School of Public Health

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RESEARCH MENTOR/DEPARTMENT CHAIR

Lance Price

ABSTRACT

Effects of Marijuana Legalization on Alcohol Related Automobile Fatalities

I applied the Navigation Guide systematic review methodology to conduct a systematic review to determine the effects of marijuana legalization on alcohol-related automobile fatalities with the hypothesis that has marijuana legalization potentially replaced alcohol and thus decreased alcohol related automobile fatalities in legalized states?

I applied the steps of the Navigation Guide to conduct my systematic review. First, I formulated my PECO statement with the following components: Population studied: General population including drivers, passengers, pedestrians and others of marijuana legalized states. Exposure studied: medical and recreational marijuana legalization and laws in states. Comparator: State population where any kind of marijuana is illegal. Outcome: alcohol-related and marijuana-related automobile fatalities. Next, I searched PubMed, Scopus and Cochrane databases for articles published from 2000 to 2019 and identified 3000 papers related to my topic. After reviewing the titles and abstracts, I identified eight articles that met my selection criteria. Finally, I reviewed each of these articles in detail, evaluating potential risk of bias and rating the overall quality and strength of the evidence linking marijuana legalization to alcohol-related automobile fatalities.

Based on the body of literature, I rated studies generally with "low" risk of bias and rated the overall body of evidence as "moderate" quality with "limited" evidence for an association between alcohol-related automobile fatalities with marijuana legalization. The evidence was limited by the heterogeneity of association estimates reported by a small number of studies and the fact that chance, bias, and confounding could not be ruled out with reasonable confidence.

On the basis of application of the Navigation Guide systematic review methodology, I concluded that there is "limited" evidence supporting an association between marijuana legalization and reduced alcohol-related automobile fatalities.

Education

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RESEARCH MENTOR/DEPARTMENT CHAIR

Gary White

ABSTRACT

Concepts of Community among Physics Majors and Learning Assistants

Current literature has studied the transformation of physics identity development in Learning Assistants (LAs): undergraduate students who provide support for student learning in introductory STEM classes. The standard physics identity framework utilizes three aspects, recognition, interest, and competence/performance, to track how students become 'physics people'. Does being an LA have a unique effect on the transformation of physics identity compared to students who do not participate in the program? In this study, the experiences of students in the Physics LA program are compared to the experiences of those who study physics but have not participated in the program at the George Washington University. We are interested in how participation in the LA program influences physics identity and if there are certain trajectories of identity development unique to certain populations of students. We analyze 15 interviews conducted by students belonging to three different populations (5 from each population): LAs who are not physics majors, LAs who are physics majors, and physics majors who are not LAs. By comparing the coded language used by interviewees to existing identity development frameworks, we hope to better understand the details of participation in the LA experience on participants' practice and beliefs of community. The results of this study will be used to identify critical elements of LA program structure that influence physics identity and inform how beliefs of community influences both LAs and physics majors in their physics identity development.

Education

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RESEARCH MENTOR/DEPARTMENT CHAIR

Michelle Kelso

ABSTRACT

YesSheCanCampaign: The Climb Is Our Story

According to the American School Counselor study, across high schools in the United States of America, the average student-to-school counselor ratio is 311 students 1. School counselors are essential in supporting high school students through the college and career process. Many high schools in the United States lack the funding and resources to ensure every student is prepared for college and their careers. YesSheCanCampaign is a youth-led 501c3 nonprofit organization that provides educational resources, programming, and professional development to youth nationwide. YesSheCanCampaign's purpose is to inspire and empower girls, young women, and youth, everywhere to push beyond all limitations and work towards pursuing their education. YesSheCanCampaign identified a public school in Washington D.C. whose curriculum did not incorporate college preparation and career readiness courses. After receiving feedback from students and staff, the YesSheCanCampaign developed a college and career readiness pilot program to assist those high school students on their college and career journeys. The program is a year-long program and the YesSheCanCampaign facilitated the program four times a week. Our research consisted of concluding how can college and career mentoring for high school students by their near-peers (college students) be more successful in helping them prepare for the future. Through our program, students learned valuable skills from personal branding to the college application process. Our organization and program are indeed preparing students for college and their careers. We are also inspiring our students to dream bigger and develop innovative ways to help others on their climb. The Climb Is Our Story!

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ABSTRACT

Building a Culture of Wellbeing for Graduate Students: Blending Community and Individual Practices to Improve Sense of Belonging, Equity, and Wellbeing

Studies suggest that graduate students are at greater risk for mental health issues than those in the general population. From impostor syndrome and feeling out of place, to periods of isolation and constant deadlines, graduate school presents many challenges to students' mental health. In addition, students often experience financial strain, complex relationships with advisers, and an uncertain job market. In one study, 41% of graduate students reported moderate to severe anxiety and 39% moderate to severe depression, incidence rates that are six times more prevalent than in the general population. Although it is important to address mental health issues such as anxiety and depression, we advocate for a focus on cultivating positive indicators of mental health such as flourishing, sense of belonging, and subjective wellbeing, all of which have been shown to be amenable to intervention. By cultivating wellbeing, students can buffer themselves from the negative impacts of stress and anxiety associated with graduate school. We are currently piloting the inaugural year of the GSEHD Wellbeing Initiative. We have implemented several programs for building a culture of wellbeing for graduate students to improve connectedness, equity, and wellbeing. In the Fall 2019 Semester, our team conducted the Fall Fair for Wellbeing, a workshop on Time & Stress Management, and developed a website of resources. As we look to the Spring 2020 Semester we have a series of programs and faculty collaboratives that will continue to address the wellbeing of GSEHD students. We propose to share preliminary findings associated with the pilot. We will discuss feasibility concerns related to in-person vs. online interventions, as well as best practices associated with intentional partnerships. During the 2020-2021 academic year, we will conduct a mixed-methods participatory action research study. In year two, we plan to employ community-based research methods to identify students' and community perceptions on current wellbeing practices, needs, and solutions to improve individual and community wellbeing practices. Utilizing the findings from the qualitative data collection phase of the study, current literature, and best practices for graduate student wellbeing in communities, we plan to develop programs that use positive psychological interventions to improve overall wellbeing on a larger scale. Positive psychology is not a remedy for problems, but by focusing on maximizing capacities and inner strengths, these interventions may help us become more aware of our capabilities and see the positive around us.

Education

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ABSTRACT

Their Voice, Their Future: Using Universal Design for Assessment to Support Authentic Youth Engagement in Transition Planning

Transition assessment represents the foundation of efforts to establish congruence between students' goals, strengths and needs and the potential postschool environments within which they plan to achieve their goals (Neubert & Leconte, 2013). Although practitioners may find it challenging to assess students with varying needs or learning profiles, the principles of universal design (UD) offer one avenue for proactively developing or modifying informal assessments to meet a range of student needs. The application of UD to transition assessment tools provides students with multiple options in terms of representation, engagement, and expression (CAST, 2018). Drawing from research on universal design for research (UDR) and universal design for assessment (UDA), this poster provides practitioners with a toolkit for applying the principles of UD to transition assessment. Additionally, the poster will offer a case example of strategies that were applied to a practitioner-developed assessment, currently in use in a community-based learning program at one urban high school.

Education

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ABSTRACT

Impact of Earth Science Integration on Student Learning in a High School Chemistry Course

The Next Generation Science Standards adopted throughout the country has generated significant reforms in science education, leading many school districts to incorporate an integrated approach to science courses. The purpose of this study was to investigate the implementation of an integrated chemistry and earth science course at a large, urban public school district by identifying changes in students' thinking in terms of integrated science content, science practices and contextual factors based upon students' and teachers reflections of their curricular experiences. Data were derived from three sources: (a) student pre- and summative unit assessments as evidence of students' change in integrated content knowledge; (b) student learning artifacts from lesson exemplars demonstrating students' proficiency in science practices and (c) semi-structured interviews from teachers and students to contextualize student learning evidence. Multiple choice items were scored using a binary approach (correct/incorrect). Constructed response items and students' learning artifacts were scored using researcher-generated rubrics. Students' scores were analyzed using SPSS to conduct paired and independent samples t-tests. Interview transcripts were analyzed using open coding to establish emergent themes. Analysis of student learning data indicated significant growth from the pre- to post-test ($p<.01$). Students made greater gains on traditional-style assessment items compared to integrated-style assessment items pre-to-post ($p<.01$). Analyzed student learning artifacts suggest students are garnering experiences integrating science practices and content with an emerging proficiency. Student learning gains suggest a degree of readiness for the major shifts enacted by adopting the NGSS. Interview data demonstrate a similar pattern of receptivity, recognizing the challenges experienced in the early stages of curriculum implementation. Emergent themes between students and teachers formed two categories: synergies and tensions. Two synergistic themes were related to the coherence of specific topics and an emphasis on metrics and success measures. Two tension-related themes pointed to different views on the role of local phenomena/data and teachers' instruction. Analyzing evidence from multiple sources and perspectives are essential in evaluating curriculum implementation amidst major reforms in science education. Elucidating intricacies among teachers' and students' reflections can further inform curriculum revision and professional learning supports. Identifying successes and challenges among student learning can provide clarity in adapting instruction to support learning. This work also has the potential to locate critical areas to develop research-based learning progressions in students' conceptual understanding, particularly in an integrated approach to learning science.

Education

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ABSTRACT

Mental Health Issues and Counseling Services Use Among International Students in the U.S.

Considering the persistently growing trend of international student populations, their countless contribution to the American economy, education, and cultural diversity, and the literature gap of a dearth of research studies looking at international students' mental health issues, psychological needs, and counseling seeking, we aim to call for academic awareness and endeavors to examine various topics concerning international students and promote their overall well-being in the United States. International students in the United States experience not only similar stressors as domestic students do (e.g., academic stress, adjustment issues), but also extra challenges that domestic students would not anticipate (e.g., language barriers, acculturative stress). In spite of numerous stressors and challenges, studies showed consistent results of low rate among international students seek counseling services. What prevents international students seeking counseling services? With the growing number of international students studying in the United States, more mental health issues have been presented in this population. Our literature review intends to identify the current needs of counseling services among international students in the United States and the barriers for them to seek help. Implications will be introduced to increase counseling awareness and to inform counseling practices from a multicultural perspective.

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ABSTRACT

The Skills of Tomorrow: Market Research for Developing 21st Century Skills Curricula for the Global South

Skills of the future, also known as 21st century skills, are needed assets in this tech-driven world and are highly sought out by employers as traditional jobs are being replaced by automation. To ensure students are prepared for these new careers, education policies must shift and curricula will need to be rewritten. While select agencies, governments, and school systems have already started this transition, this paper focuses on the curricula in the Global South and how students in low-resource contexts are learning these skills.

The research conducted through this project will review literature on skills of the future, seeking information from both academic pieces and business reports. It will also analyze what curricula have been developed to improve students' skills needed for future employment, as well as whether it is relevant to low-resource contexts and marginalized groups in those regions. This includes the accessibility of the curricula in these contexts, as applicable. Ultimately, the intention of this research is to define the skills needed in future curricula and evaluate the current curricula available in the Global South.

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ABSTRACT

Urban American Indian Students Negotiating Civic Identity

Students in urban school systems often experience civic disjuncture, a mismatch between the ideals they are taught in civics courses and the realities they experience when they interact with government institutions (Rubin, 2007). For urban Indigenous students in public schools there can be a double civic disjuncture that inhibits building of their civic identity as adolescents, a key period for this development (Hart & Atkins, 2002). This proposed study examines an urban school, and Native Youth Council within a state that has mandated social studies curriculum on Indigenous history; civics and current events is taught in each grade K-12 to better understand what impact this curriculum has on urban AI civic identity.

Acknowledging that Indigenous ways of knowing are relational (Wilson, 2002) the study examines the local urban Indian center alongside of students daily lives in school as a potential space that civic identity might be created. The study is framed by Safety Zone Theory (McCarty, 2006) and TribalCrit (Brayboy, 2005) as theories that provide explanations on why the Indigenous civic identity constructs of sovereignty, self-determination and dual citizenship are not addressed in the curriculum of 48 states, and how these are addressed within the social studies class and Native youth council here. Critical ethnographic methods are employed in the collection of data through in classroom observations, semi-structured interviews and focus groups with urban Indigenous students.

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ABSTRACT

Invisible yet Hyper-Visible: The Gendered Experiences of Women in the US Military

The rise in social awareness of the experiences women encounter in professional environments has included pressure within the military to address issues pertaining to sexual violence and discrimination. The proposed Combating Military Sexual Assault Act of 2019 was but one of many attempts from civilian and military leadership alike to address the continued prevalence and rise of sexual assault and harassment within the US armed forces. Attempts at eliminating such misconduct have been met with negligible success and the military continues to seek initiatives to prevent such misconduct contrary to good order and discipline. Such misconduct only highlights the particular challenges associated with the gender integration of the armed forces and has become ever more apparent with the repeal of combat exclusion policies as of 2013. Beyond efforts to raise awareness, little inquiry has been done to understand the many ways in which gender manifests itself in women's military service and the military environment. Gendered experiences extend beyond issues of misconduct and include the multitude of ways in which gender plays a role in the careers and experiences of women at all levels of military service. Specifically, gendered experiences incorporate those experiences, both formal and informal, reflecting or involving gender differences or stereotypical gender roles.

This purpose of this quantitative research study was to understand the gendered experiences of active-duty senior enlisted women in the US military. The study utilized the lenses of gendered organizations theory, feminist institutional theory, and social learning theory. In-depth interviews were conducted with twelve participants representing all three senior enlisted ranks of the four military branches within the Department of Defense. Preliminary findings included organizational structures, institutional culture, gendered misconduct, and learning to navigate as fundamental categories of the gendered experiences of the participants along with emergent themes of leadership, intersectionality, voice, and family planning.

From a theoretical perspective, consideration of the multitude of ways in which gender permeates professional environments and the subsequent experiences of their members facilitates a more comprehensive understanding of organizations and institutions and the ways in which members navigate them. Furthermore, insight into the uniquely gendered structures and culture of the US military enables a more conducive approach to high-profile issues such as sexual violence and discrimination as well as the transferability and applicability to other traditionally male-dominated professions.

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ABSTRACT

Dialogue for Equity and Development for Educators: An Intervention for Identity Inclusion in American Education

The pedagogy that is applied within the US public school system produces a closed-ended look at history and other social sciences through a Eurocentric lens and perpetuates an oppressive structure. The lack of representation in curriculums and classrooms illustrates a persistent trait of discrimination, bias, disrespect, and ultimately the erasure of identities from American education and history. The society we live in shapes who we are as individuals. Whether a person belongs to a dominant group or a marginalized group, both work together as a system. Choosing to resist or comply impacts our self-awareness and serves as the motivator and the contribution we give to that same society. When students see themselves underrepresented or negatively depicted in the content that they learn, their attention falls between two places. One, students internalize harmful and negative connotations, both consciously and subconsciously, about themselves as a result of the content. The second, students reject the content altogether and fail to contribute academically.

Citing the concept that people of all ages and backgrounds learn best in environments that they are familiar with, implementation of identity and diversity training for all public-school educators is an intervention created for authentic and substantial change. Before we can address the classroom, we must first address ourselves (as educators). While, ideally, students serve the role as the top priority within the realm of education, teachers often get lost within the cracks of public policy, curriculum standards, school administrations, and parent interactions. This proposal will serve as the catalyst to create a productive dialogue centered on accessibility and equity of opportunity of education for the American school system by utilizing the pedagogy of emancipatory education and an education and schooling model framework as the basis for analysis.

Through the use of case studies, semi-structured interviews, and formal data, the overall research of this paper will provide methods curated to address the needs of the nation. This intervention model can be modified and configured for adjustments at any bureaucratic level, beginning with state-mandated education. The results of this research should be used to further the necessary changes within the US public school system to benefit all students. The idea is not to teach teachers cool techniques and ice breakers to use in their classrooms. The rationale is to provide teachers with an opportunity to enhance their personal value that was not a part of their formal schooling.

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ABSTRACT

Wisdom from Women in West Bengal: Intergenerational Perspectives on Early Childhood from Mothers and Grandmothers

Early childhood is a key area of human and social development, yet it still is struggling to develop adequate resources and programming to meet the needs of families. Because family knowledge may be passed down from generation to generation, social services that are targeted to only helping mothers may not succeed in their interventions if other family members also have an influence on mothers. This study sought to find out how mothers and grandmothers compare in their views of early childhood amongst two groups in West Bengal – the Urban Poor in Kolkata district and the Santal Tribe in Birbhum district – and understand what the implications are for the design and implementation of early childhood interventions. Using the Nurturing Care Framework and the MICS surveys for a theoretical foundation for inquiry, I conducted focus group interviews with 55 mothers and 27 grandmothers across the two districts. Overall, both the mothers and grandmothers recognized how their status as belonging to marginalized groups made education a necessity for their young children and childrearing is highly focused on how the best educational opportunities can be made accessible to the young children in their lives. The role that NGOs play therefore is paramount to bridging the gap between families and opportunities. Different factors shaped the influence that NGOs had on families, and when NGOs had special meaning or connections with families – such as the NGO in Birbhum where multiple generations of Santal tribal families were assisted – families and especially grandmothers could see the value. When grandmothers were not engaged, they sought that engagement. For mothers, and grandmothers as well, understanding their children's' needs means being cognizant of what is currently happening in the society and using socio-cultural norms passed down to them as an anchor. The paper concludes with recommendations for early childhood interventions to consider in aligning programming with family engagement.

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ABSTRACT

Promoting Successful Organizational Change in Bureaucracies

In the past 50 years, large bureaucracies have increasingly dominated the American economy. As organizations have grown in size, they have simultaneously faced increasing pressure to continually adapt to rapidly shifting economic, technological, and global trends. This increased pressure for frequent organizational change provides unique challenges to large bureaucracies whose structures are not always conducive to the level of agility globalization and the ever-changing economy require. Given the converging trends of a global environment requiring more frequent change and organizations growing and bureaucratizing, it will be increasingly important to understand how to drive successful organizational change across massive bureaucratic institutions. This study examines academic research and practitioner-based literature on organizational change in bureaucracies and provides recommendations to help large bureaucratic organizations improve their chances for successful organizational change.

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ABSTRACT

Subjective Well-Being, Self-Care and Mental Health Help-Seeking Tendencies among DACA Students at a Large Public Institution in the Mid-Atlantic

Deferred Action for Childhood Arrivals (DACA) is an immigration policy introduced by the Obama administration in 2012, designed to provide work and study authorization to a new generation of previously undocumented immigrants who entered the United States as minors. As of 2019, the DACA program has provided amnesty to 798,000 young people, however the Trump administration has reacted to this policy with hostility. In light of an uncertain political future, increasing number of DACA recipients are falling out of legal status and becoming undocumented again. This sudden change in status can have significant impacts on psychological distress among the program's beneficiaries; however, little is known about how recipients engage in self-care or access mental health resources. The present study uses grounded theory to understand how DACAmented young people engage in self-care, explain their help-seeking behavior, and gain access to health resources while studying as a post-secondary student. Through the use of sequential interviews and transcript analysis, this research seeks to answer the following questions: how do DACA recipients at a large public university in the Mid-Atlantic state of Maryland understand and experience psychological distress? Specifically, the research seeks to understand how DACA recipients understand personal self-care and how social relationships and family dynamic impact help-seeking tendencies during their undergraduate studies. Furthermore, this research aims to understand how DACA recipients describe the process of accessing formal health resources as college students. Based on an analysis of the data, a theoretical framework will be developed to explain the experiences of this comparatively understudied group of students.

Keywords: DACA, psychological distress, wellness, self-care, help-seeking tendencies, Grounded Theory, Social Network, Familial Relationships

Educational Health Services

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ABSTRACT

Analysis of Evolution and Desired Future Direction of the Doctor of Public Health Education in the United States: A Qualitative Study

Recently, there has been a renewed interest in accurately determining the public health workforce size and composition to ensure that there are enough public health human resources to support the complex health care system. After experiencing the hookworm control campaign during 1909-1914, the need for a standardized system of public health training began to be raised to reflect the pressing necessity that prevention of disease should be distinct from clinical medicine that is conducted by dedicated full-time public health practitioners who are professionally trained. Research on the public health workforce and on standardizing terminal professional doctoral education—Doctor of Public Health (DrPH)—has been extensive in recent years. However, it is still unknown how a DrPH degree can be standardized across the United States to empower and educate the future leader of public health.

The purpose of this study is to find out the DrPH degree's strength, weakness, evolution, and desired future direction within 28 identified Council on Education for Public Health (CEPH)-accredited DrPH programs in the United States and its territories.

30-minute in-depth interviews with DrPH directors were conducted. A total of 45 former or current DrPH directors, or point persons from 28 CEPH-accredited DrPH programs were identified and then contacted via email. The response rate of participation agreement was 51% (23/45), and 96% (22/23) of interviews were audio-recorded upon permission.

Strengths of DrPH programs derived from school location, access to public health work, priorities/core expertise, school reputation, flexible or cohort model, executive program, faculty capacity, multiple concentrations and tracks, and partnership with other organizations/universities. On the other hand, most participants pointed out that lack of funding and high tuition cost is the major challenges of the DrPH program. A number of the DrPH programs were recently launched or changed/will have changed the structure from departmental-based to school-wide, which have not been firmly established. DrPH programs have been trying to deal with the real public health issues, changing the delivery of education to hybrid or online model, building more partnerships with community partners and other universities. In the future, DrPH degree is expected to be recognized as the premier practice degree in public health.

Educational Health Services

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ABSTRACT

Lack of Telemedicine Training in Academic Medicine: Are We Preparing the Next Generation?

Telemedicine focuses on providing medical care to patients in remote locations using telecommunication technologies. It has been shown to be cost-effective, improve health outcomes, and enhance patient satisfaction. This study examines the extent to which medical students and resident physicians are exposed to telemedicine during training. The authors accessed the American College of Graduate Medical Education (ACGME) Residency Milestones from specialties and subspecialties mentioned in the 2018 Milestones National Report and searched for key terms including "Technology," "Telemedicine," "Telehealth," "EMR," "Electronic Medical Record", "EHR", "Electronic Health Record", "Electronics," and "Social Media." The authors also accessed the 2018 AAMC "Curriculum Inventory and Reports" to retrieve data from surveys of medical schools that included telemedicine in required courses and electives for medical students from 2013-2018. From the 104 ACGME specialty milestones, only one specialty (Child and Adolescent Psychiatry) mentioned telehealth in its ACGME Milestone document. According to the AAMC data, the number of medical schools surveyed increased every academic year from 140 in 2013/2014 to 147 in 2017/2018, and telemedicine education in medical school increased significantly from 41% in 2013/2014 to 60% in 2017/2018 (p= 0.0006). However, the growth in telemedicine education plateaued from 56% in 2015/2016 to 60% in 2017/2018 (p=0.47). Familiarizing medical students with telemedicine is essential: the next generation of healthcare providers should be equipped with knowledge of telemedicine as a valuable skill to serve populations that do not have direct access to quality medical care. Methods of implementing telemedicine education into more medical schools and residency programs merit further study.

Educational Health Services

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ABSTRACT

Integrating Google Collaborative Tools to Enhance Classroom Learning Amongst Post-baccalaureate Pre-medicine Students

"Crowdsourcing" is a method of content creation where multiple authors collaborate on a single project. Crowdsourcing can be an effective means of creating high-quality educational resources quickly. To determine whether emphasis on working together and creating crowdsourced tools improves student performance and enthusiasm in a post-baccalaureate pre-medicine program, we introduced a collaborative note-taking process to an introductory general biology class.

Twenty nine students (20 female, 9 male) in an introductory undergraduate biology class studied according to their own habits for the first exam. They were then instructed to sort themselves into small groups to utilize Google Docs to crowdsource a collective note set. Collaborative learning, either through the document or in the form of group study, was encouraged for this phase. Exam scores were compared and self-report surveys with Likert-scale based answers were administered in REDCap.

While, there was no significant difference in scores between the exams (p= 0. 40), all (100%) students agreed that team-working skills are vital for pre-health students. A majority of students 24/29 (83%) agreed that patients would ultimately benefit if health and social care professionals worked together, and 16/29 (55%) agreed that shared learning would help them think positively about other students. 16/29 (55%) students felt their time was better spent learning individually than with other students, though a majority 25/29 (86%) of the class felt they were well matched with their study group. Of the 28 students surveyed after collaborative work (1 student withdrew), 8/28 (29%) reported increased group work between the first and second exam. A smaller percentage 5/28 (18%) students reported a decrease in group work but also reported spending less than half of their time on group work at baseline. Neither of these groups showed a statistically significant change in grade outcome between exams (p = 0. 39, p=0. 20 respectively). Interestingly 9/28 (32%) students wanted to continue using the google docs, though only 6/28 (21%) of students found the docs helpful.

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ABSTRACT

Stochastic Maximal Coverage Problem for a Naval Task Group with Random Coverage and Threat

We present a new stochastic programming model with decision-dependent probabilities for air defense formation and effective coverage of a naval task group. The problem determines the defensive resource allocation policy that maximizes the probabilistic protective coverage level of the entire naval group. We model the workload of a ship as an endogenous uncertainty. A load-discounted function is introduced to describe the impact of allocation decisions on its coverage efficiency. We propose a joint chance constraint formulation to optimize the coverage of each sector subject to uncertainty regarding weapon accuracy and direction of attacks. A Boolean framework is introduced to reformulate the probabilistic constraint. Several reformulation-linearization techniques are presented to reformulate nonconvex problems as linear ones, and we further enhance these reformulations with valid cuts to yield tighter bounds. The efficiency of the algorithm is tested on randomly generated instances. Finally, we propose valid insights for a naval task group under different combat scenarios.

Engineering

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ABSTRACT

Advanced Control and Energy Management Schemes for Power Grids with High Proliferation of Renewables and Electric Vehicles

A grid transformation is needed to integrate large-scale variable renewable energies (VREs) and electric vehicles (EVs), in order to address the environmental concerns. Organizations and governments have set ambitious targets for the integration of these emerging resources into the modern power grids to build, plan, and operate a clean and sustainable energy landscape. This presentation introduces new control and energy management schemes for power systems to smoothly integrate the emerging energy resources and loads at large-scale, i.e., VREs and EVs. The coordination of lower level control and higher level energy management system can ensure the safe and secure operation of the power grids under both transient dynamics and steady-state conditions. The multi-timescale flexibility of aggregated EV load is also quantified using the proposed control and energy management scheme.

Engineering

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ABSTRACT

Demonstration of Practical Mainstream Deammonification Schemes Balancing Treatment Efficiency with Complexity and Cost

DC Water Blue Plains Advanced water resource recovery facility treats 384 MGD (1400 MLD) wastewater to meet stringent nutrient limits (Total phosphorous (TP) < 0.17 mg P/L and Total nitrogen (TN) < 3.7 mg TN/L). In a year, this operation costs $8M for methanol, $0.6M for alkalinity supplementation, and $1.5M in energy demand for aeration. For plants facing stringent limits, mainstream deammonification via NOB (nitrite oxidizing bacteria) out-selection or the coupling of partial denitrification and anoxic ammonium oxidizing bacteria (PdN-AnAOB), offers vast opportunities for energy and treatment cost savings.

However, there has been no full-scale mainstream deammonification facility in operation, despite research's devotion for the past eight years. This prevalent reluctance is summarized by the following reasons: (i) challenge and unreliability of NOB out-selection due to system and seasonal dynamics; (ii) capital investment requirements because of the limitation of existing infrastructure, and (iii) risk of implementation and violation of effluent limits, especially with significant reliance on AnAOB contribution. This study seeks to conquer some of these challenges by re-thinking utilization of PdN-AnAOB pathway from the perspective of utility managers.

The overall objectives of this research was to develop novel and risk adverse concepts to boost full scale adoption of PdN-AnAOB mainstream deammonification. Furthermore, the influence of different aeration modes and partial denitrification on nitrogen removal treatment, as well as operational cost savings provided by PdN-AnAOB were evaluated. A 360 L mainstream nitrogen removal pilot was operated at Blue Plains with dedicated zones for nitrification (AvN), PdN-AnAOB, and subsequent polishing by full denitrification and reaeration. Intermittent AvN operation was operated with 30 minute cycles and a DO setpoint of 1.5 mg O_2/L during aerobic times, while continuous was operated with the ability of DO concentrations to vary between 0.1 and 3 mg O_2/L in order to meet target ammonium levels. The pilot received secondary effluent with soluble COD/N ratio of 1-2. Each scenario was run for at least 3 SRTs or 60 days.

This study demonstrated a novel application concept that integrates lessons learned from previous comprehensive research, and utilities' desire for low capital investment and risk management. It reaffirmed the efficiency of intermittent aeration control schemes in using wastewater carbon for total nitrogen (TN) removal and revealed that inclusion of partial denitrification and AnAOB with the continuous counterparts can achieved similar operational cost savings without complexity and high investment.

Engineering

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ABSTRACT

Self-Centering Pendulum Shear Walls

This research project addresses a grand challenge in structural engineering by developing a new concept in the seismic design of post-tensioned shear walls. It aims to develop structural systems that are capable of resisting extreme hazards with minimum or no damage. The main task of the set-up stage of the project is to make sure the test specimen is set-up properly for the purpose of providing full support from the foundation. The assembly of the testing pieces has to be seamless and perfect for the test specimen to perform well.

Engineering

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ABSTRACT

Gelation Factor as Potential Indicator of Overcooking Solids in Thermal Hydrolysis Process

Sludge rheology change due to THP is perhaps the most important consequence of the technology on sludge treatment as it allows higher digester loading rate and aids in final dewatering. Increased THP temperatures (or reaction times) have shown to increase availability of soluble organics and proteins for anaerobic digestion and decrease viscosity. The only reason to avoid excess temperature was the formation of recalcitrant organic nitrogen. A recent study, however, also indicated that THP conditions might impact the macro-structures of certain proteins and polysaccharides, and consequently biogas production. At increased temperature treatment, protein structures (i.e bovine serum albumin) are changed on a macro-level from a liquid to gel and eventually solid structure. This change caused by formation of intermolecular bonds. A decrease in biodegradability was measured for proteins in gel and solid structures, respectively, in comparison to its denatured soluble form. This would indicate that desired THP operational condition to maximize digestion depends on the substrate composition and the current default temperature (165 °C) and reaction time (30 min) might not always result in the desired biodegradation. In this project the gel formation potential of the sludge in function of the thermal hydrolysis pretreatment (THP) conditions were quantified as well as its impact on digestibility and dewatering at DC Water's Blue Plains Advanced Wastewater Treatment Plant (AWTP). A method named gelation factor was developed to represent the gel behavior of THP sludge with different sieve sizes. The Full Scale THP at different thermal dose showed increased thermal dose results in increased gelation, and as a result of that having a negative impact on soluble COD concentration of THP sludge after an optimum thermal dose of 4950 min-°C (equivalent to 30 min at 165 °C). When the high gelated sludge from THP went into the anaerobic digesters, hydrolysis and biogas efficiency were negatively impacted. Both Pilot and Full Scale THP and AD operations showed a similar trend. The optimal range for maximized anaerobic digestion (AD) kinetics was found at 3900 to 4950 min-°C or 25 to 30 min at 165 ∘C temperature. Finally, both pilot and full scale THP results indicated gelation factor is sensitive parameter for optimizing THP conditions.

Engineering

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ABSTRACT

Strain-Engineered High Responsivity MoTe2 Photodetector for Silicon Photonic Integrated Circuits

In integrated photonics, specific wavelengths are preferred such as 1550 nm due to low-loss transmission and the availability of optical gain in this spectral region. For chip-based photodetectors, layered two-dimensional (2D) materials bear scientific and technologically-relevant properties such as electrostatic tunability and strong light-matter interactions. However, no efficient photodetector in the telecommunication C-band has been realized with 2D transition metal dichalcogenide (TMDCs) materials due to their large optical bandgap. Here, we demonstrate a MoTe2-based photodetector featuring strong photoresponse (responsivity = 0.5 A/W) operating at 1550 nm on a silicon micro ring resonator enabled by strain engineering of the transition-metal-dichalcogenide film. The non-planarized waveguide structure can induce a spatially tunable bandgap of MoTe2, resulting in large photo-response in the telecommunication wavelength, in an otherwise photo-inactive medium when unstrained. Unlike Graphene-based photodetectors relying on a gapless band structure, this semiconductor-2D material detector shows a ~100X improved dark current, enabling an efficient noise-equivalent power of just 90 pW/Hz0.5. Such strain-engineered integrated photodetector provides new opportunities for integrated optoelectronic systems.

Engineering

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ABSTRACT

Acoustic and Mechanical Characterization of 3D-Printed Gelatin Methacrylate (GelMA) Scaffolds for Tissue Engineering Applications

Gelatin methacrylate (GelMA) is a highly biocompatible, biodegradable material and a 3D printable option for constructing tissue engineering scaffolds. These scaffolds are promising alternatives to conventional tissue replacements such as autografts and allografts. Improved material characterization of GelMA is necessary to optimize preparation techniques, evaluate tissue similarities, and validate tissue engineering potential. Conventional material property testing methods are through destructive, one-time measurements. Testing methods that are nondestructive are desired for evaluating long-term changes. In the present study, ultrasound techniques were utilized to measure mechanical properties of GelMA tissue scaffolds in tissue engineering applications. Varying concentrations of GelMA and ultraviolet light crosslinking time produced scaffolds with a wide range of material properties. Ultrasound pulse-echo techniques were used to evaluate the physical properties of the scaffolds. Utilizing this non-destructive acoustic characterization procedure, parameters including speed of sound, acoustic impedance, bulk modulus, and attenuation coefficient were measured. To further evaluate the material properties of the scaffolds, compression testing was also performed. The differences among the preparation protocols of the scaffolds will be discussed. Physical parameters of GelMA were found to be similar to those of native tissues, demonstrating that GelMA scaffolds are biomimetic. Furthermore, the effects of GelMA concentration and crosslinking time will be discussed to inform the selection of preparation parameters for specific tissues. Acoustic characterization proves to be a promising technique in evaluating the structure and function of the scaffolds. Non-destructive ultrasound testing could serve as an indicator of tissue scaffold health and provide real-time monitoring in vivo.

Engineering

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ABSTRACT

Experimental Investigation of Self-Oscillating Synthetic Vocal Fold Acoustics

Physiological speech disorders are associated with a change in modal behavior of vocal folds and alterations in the acousto-fluid dynamic behavior of airflow in the human vocal tract. Human vocal folds are located in the larynx, which connects the trachea and the pharynx in the anterior compartment of the neck. The subglottal region includes the lungs and trachea and extends to the glottis. The supra-glottal region is superior to the glottis and extends into the open air, past the opening of the mouth. A custom-built vocal fold tract apparatus with a fixture to hold self-oscillating synthetic vocal folds and 'sub- and supra-glottal ducts' is being used to investigate the acoustic characteristics of healthy and diseased physiological conditions.

The vocal fold anatomy can be simplified into two layers – the body and the cover. The cover layer (the lamina propria) is a thin mucosal membrane that covers the entire surface area of the vocal folds. The body layer consists of a laryngeal muscle that stiffens or relaxes to control the oscillations of the folds. It is a dense muscle that engages for higher amplitude and low-frequency voice production (I. R. Titze, Principles of Voice Production, 2000). Various synthetic vocal fold configurations with different material properties are fabricated and installed in the vocal tract experimental setup.

A speech disorder known as spasmodic dysphonia is found in people typically between 30 and 50 years of age; affecting women more than men. Other speech disorders arise with the formation of small benign growths on the vocal folds, such as unilateral polyps and bilateral nodules. Such speech anomalies are commonly associated with alteration of normal vocal tract harmonics and airflow patterns. In this study, duct harmonics and distortion, transmission loss and spectrograms of vowel sounds are measured using high dynamic range microphones (Model: Bruel& Kjaer 3938-A-011, BK Connect software) and pressure transducers (Model: A-Tech XCS-093-2D) with synchronized trigger signals in the sub- and supra-glottal tracts. The spectrograms are used to detect onset time of phonation.

Our study will elucidate the role of acoustics and vocal fold aerodynamics in speech disorders and determine a baseline for phonation onset time of healthy vocal folds compared to ones that are pathologically stiffer.

Engineering

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ABSTRACT

Finite Element Modeling of Cancer Prognosis

Most mechanobiology phenomena commonly involve biological growth and deformation. In this work, we propose an innovative model of cancerous growth which posits that an expandable tumor can be described as a poroelastic medium consisting of solid and fluid components. we present a new formulation of the mathematical model and we study tumor growth by nonlinear regime to explore complex tumor growth The biot's theory is involved to Darcy's law to build our constitutive equations. Our biologically informed mechanical description of tumor growth dynamics, we derive the governing equations of the tumor's growth and incorporate them with large deformation and materially nonlinear constitutive equations to improve the accuracy and efficiency of our simulation. Meanwhile, the dynamic finite element equations (DFE) for coupled displacement field and pressure field are formulated and solved. Numerical solutions are presented and discussed.

Engineering

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ABSTRACT

Engineered Coal: A New Green Product for the Coal Industry

This paper presents an overview of a joint effort by teams from George Washington University and Mississippi State University to develop green technologies for the US coal industry. The methodology involves a combination of engineering and design of the solar hybrid kiln and the discovery of a chemical method to treat the coal to reduce emissions and sequester the carbon. The novel process is the development of low-cost adsorbents for nitrate and phosphate nutrients for application in agriculture and urban landscape architecture. Phosphorus, an essential primary nutrient for photosynthetic organisms in aquatic environments, is naturally present in low concentrations. Phosphate is a major cause of eutrophication since it is often the limiting nutrient for explosive algal growth. Cyanobacterial blooms can release soluble neurotoxins and hepatotoxins, killing fish or livestock when ingested and causing severe hazardous health effects in humans.

Another recent discovery is that the product can be made into a coal pellet used for a fuel when the engineered product is treated with cornstarch. This engineered coal will burn with reduced emission because the added salt will scrub sulfur. This pellet will replace wood pellets because the availability of feedstock and the cost

Our Industrial Partner is Tim Warden the General Manger of Englo Global from West Virginia who has working to secure funding to manufacture the products.

Engineering

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ABSTRACT

Additive Manufacturing and Characterization of n-type Bismuth Telluride (Bi2Te2.7Se0.3)

Renewable energy sources are vital to meet the world's energy demands and reduce carbon emissions. It is estimated that 20-50 % of energy is lost as heat during industrial processes. Thermoelectric devices are solid-state energy conversion devices that can be used to convert heat to electricity or vice versa. The traditional manufacturing process for thermoelectric devices is labor intensive and time-consuming, it involves powder synthesis, cutting, and device assembly. Traditional manufacturing limits the devices to planar geometries and introduces challenges in applying a thermoelectric generator to recover waste heat. Selective Laser Melting, an additive manufacturing technique, builds components layer-by-layer and can eliminate steps in the manufacturing process. Complex geometries can be obtained to optimize the shape of the thermoelectric legs and engineer the device to fit the system's needs. This research explores selective laser melting of bismuth telluride, a common thermoelectric material. We manufactured ingots of n-type bismuth telluride, characterized their thermoelectric properties and analyzed the microstructure of the material. Laser processing parameters significantly influence the structure and transport properties of the material. The microstructure of the laser melted samples had a high amount of porosity and low relative density. X-ray diffraction and energy dispersive spectroscopy revealed the laser melted material had the same composition as melt grown bulk material. Transmission electron microscopy images showed nanoscale oxide inclusions within the grains of the laser melted material. This contributed to a shift in primary charge carriers and caused the material to switch from n-type to p-type. The findings indicate that the laser parameters influenced the porosity, microstructure, and thermoelectric properties of n-type bismuth telluride.

Engineering

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ABSTRACT

Measures to Evaluate Generative Adversarial Networks Based on Direct Analysis of Generated Images

The Generative Adversarial Network (GAN) is a state-of-the-art technique in the field of deep learning. A number of recent papers address the theory and applications of GANs in various fields of image processing. Fewer studies, however, have directly evaluated GAN outputs. Those that have been conducted focused on using classification performance (e.g., Inception Score) and statistical metrics (e.g., Fréchet Inception Distance). Here, we consider a fundamental way to evaluate GANs by directly analyzing the images they generate, instead of using them as inputs to other classifiers. We characterize the performance of a GAN as an image generator according to three aspects: 1) Creativity: non-duplication of the real images. 2) Inheritance: generated images should have the same style, which retains key features of the real images. 3) Diversity: generated images are different from each other. A GAN should not generate a few different images repeatedly. Based on the three aspects of ideal GANs, we have designed the measure: Likeness Score (LS) to evaluate GAN performance, and have applied them to evaluate three typical GANs. We compared our proposed measures with three commonly used GAN evaluation methods: Inception Score (IS), Fréchet Inception Distance (FID) and 1-Nearest Neighbor classifier (1NNC).

We briefly reviewed the three existing measures and indicated their limitations and drawbacks. IS depends on the Inception network trained by ImageNet. The pre-trained classifier may not be suited for use on some specific types of images that are not included in ImageNet (e.g., medical images) or for non-classification purposes, and IS also has no ability to detect over-fitting. FID also depends on the pre-trained Inception network and a Gaussian distribution assumption of feature vectors from the network. Our proposed method is designed to avoid those disadvantages. We have built a framework to describe ideal GANs using three criteria and discussed how the new methods fixed the problems of several existing methods. LS do not need a pre-trained classifier nor a priori knowledge of distributions, and they evaluate a GAN based on the three criteria we defined. In particular, the LS is a model-independent measure and offers a distinctly new way to measure the separability of real and generated data. Besides evaluation of GANs, LS could measure data complexity as well. In addition, we discuss how the evaluation could help us deepen our understanding of GANs and improve their performance.

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ABSTRACT

Integrating Manned and Unmanned Vehicles in Foresty and Defence Applications

The North American forest products industry depends on an abundant and varied natural resource. In Europe, tree farms provide reliable, uniform and quality lumber, and they are common in Australasia and even in the Southeast USA. In Canada and the U.S.A., the topography is less favorable and accessible for valuation, reducing the product harvest and value by the need for access to assess quality and health predominately from the ground and on foot. Pursuing this opportunity was encouraged by the potential uses in the forest industry and further potential applications have identified opportunities in defense and research.

This work presents and assesses the feasibility and potential of a novel concept using multiple unmanned vehicles (UAV), commanded and supported by a manned "Tender" air vehicle carrying a pilot and flight manager equipped to flexibility and economically monitor and manage multiple diverse UAV over inaccessible terrain through wireless communication. The proposed architecture facilitates operations and analysis on the fly, enabled by means to detect, assess and accommodate change and hazards on the spot. Further research was also encouraged by the discovery that the "Tender" vehicle suite of air-to-air UAV control and software is functionally similar to proven existing UAV "ground to air" management systems.

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ABSTRACT

Capacitive Power Processing Unit: Using Capacitive Energy Storage to Increase Micro-Cathode Arc Thruster Scalability in CubeSats

CubeSats have been gaining popularity in the satellite industry due to their low price, ease of design due to standardization, and ability to accomplish increasingly complex tasks especially when deployed in a fleet. As CubeSats are developed to host a number of intricate scientific and technology-based missions, parameters like subsystem weight and volume can become limiting factors. GWU's Micro Propulsion and Nanotechnology Lab has developed and flight-tested several variations of vacuum arc thrusters including the Micro-Cathode Arc Thruster (μCAT). These thrusters utilize a Power Processing Unit (PPU), which acts as a DC to HVDC converter and allows for the generation of plasma and arc discharge between thruster anode and cathode, resulting in thrust on the order of micronewtons. The PPU makes up the overwhelming majority (~90%) of a thruster subsystem's weight, with the heaviest component within the PPU being a ferrite-core inductor. Because of its weight and the fact that each thruster requires its own PPU to operate, the PPU limits the scalability of integration of μCATs in CubeSats.

The Capacitive Power Processing Unit (CPPU) is a modified version of the PPU aimed at addressing this scalability issue and increasing the functionality of μCATs in CubeSats. The CPPU utilizes capacitive energy storage to reduce the number of ferrite-core inductors used and significantly reduce the weight of the thruster subsystem without greatly sacrificing thruster performance. Transient analysis of the performance of circuit components, optimization of energy exchange efficiency, total power consumption, and overall weight of the PPU and CPPU will be presented and compared. Experimental thrust tests will be performed in a vacuum chamber with a pressure of ~10e-5 Torr, utilizing a thrust stand and Matrix Arc Thruster (a modified μCAT), and will be used to compare the thrust to power ratio of the PPU to the CPPU.

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ABSTRACT

Site Selection Decision Support Tool Using Geographic Information Systems and Multi-Expert Analytic Hierarchy Process

Site selection, the process of locating alternatives for new facilities, is a complex and crucial decision faced by many companies. Organizations often employ time consuming and informal market research techniques, which may fail to capture institutional knowledge or consider all feasible alternatives. Advancements in geographic information systems (GIS) have allowed for formalized methods to be adopted, but current GIS-based methodologies may only be able to study a small area using expensive software, hardware, or data. The goal of this project is to create a site selection decision support tool that can study a large area using open source GIS software and publicly available data, without the use of high-performance computing. The project client is a business that combines an urban winery, a multipurpose venue, and a restaurant into one facility. The company's site selection problem focuses on finding locations where there is a high demand for their products and services. Requirements elicitation was performed on several experts, and group aggregation techniques were applied to the traditional analytic hierarchy process (AHP) to generate weights for various decision criteria. Data for each criterion was standardized into a consistent scale and then loaded into GIS map layers. A weighted overlay technique was implemented to rank feasible alternatives in map form. Inter-market analysis was conducted using variables that capture an area's demand for weddings and corporate events, which are the company's key sources of revenue. Variables that capture demand for the organization's services include labor availability, existing event infrastructure, and wine consumption in the target region. Intra-market analysis is performed to provide granular recommendations by capturing factors such as crime statistics, accessibility, and proximity to complementary businesses. Alternatives are scored and ranked by the level of suitability. Recommendations were provided at a "census block group" level of granularity. Sensitivity analysis was performed to test model robustness, and model accuracy was validated through ex post analysis on the firm's existing locations. Opportunities exist to apply the underlying methodology presented in this project for other companies in various industries to address site selection problems.

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ABSTRACT

Viscoelastic Drop Deformation and Breakup in a Potential Vortex

In many natural and industrial multiphase flows, the suspended phase often disperses into drops of varied sizes and shapes. The drops deform along with the flow and at the same time influence the background flow. In the case of a dilute emulsion with negligible drop-drop interactions, a single drop provides complete information about the rheology. Here, deformation and breakup of a viscoelastic drop (FENE-MCR) suspended in a potential vortex is numerically investigated using a front tracking method. The nondimensional parameters that determine the problem in this case are capillary number (Ca), Reynolds number (Re), Strouhal number (St) and Weissenberg number (Wi). The shape of a viscoelastic drop is determined by a dynamic balance between inertial forces, interfacial tension and polymeric stresses. Viscoelasticity plays an important role in determining the critical capillary number, above which the drop breaks up. The study shows that viscoelasticity inhibits drop break up and thereby increases the critical capillary number. At lower inertia a viscoelastic drop deforms to a long slender shape before break-up, whereas at higher inertia a dumbbell shape is formed before breaking up. Effect of viscoelasticity on critical capillary number and drop deformation, just before breakup, is complex with different trends emerging at small and large limits of inertia. At lower inertia viscoelasticity has a significant effect on the drop break-up. However, at higher inertia, inertia dominates drop breakup and thus the effect of viscoelasticity is negligible.

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ABSTRACT

Rheological Characterization of Gill Raker Mucus in Hypophthalmichthys Molotrix, Silver Carp

The silver carp, Hypophthalmichthys molitrix, is an invasive planktivorous filter feeder fish that has infested the natural waterways of the upper Mississippi River basin due to their highly efficient filter feeding mechanism. Its extraordinary feeding efficiency is attributed to the characteristic organs called gill rakers (GRs) , found in many such filter feeders, which facilitate the efficient filtration of food particles. The motivation to investigate the rheology of the GR mucus arose from its potential to facilitate the filter feeding process in the silver carp. Fish mucus is a highly multi-functional material bearing important roles in the maintenance of protective layer in creating diffusion barriers in disease resistance, respiration, controlled release of nutritional factors, toxic components and excretion, metabolic pathways for feeding and locomotion via boundary layer modification. It is hypothesized that the GR mucus provides an adhesive function for food particles and a transport vehicle to assist in the filter feeding process. The mucus-rich fluid that is in a 'thick and sticky' state may facilitate the adhesion of food particulates. By the external action of shear forces, inducing varying shear strain rates, the permeation and transport of the same through the GR membrane is facilitated. Accordingly, rheological properties of the GR mucus of the carp were investigated for its non-Newtonian, shear-thinning nature by measurements of viscosity and storage and loss moduli using a rheometer. Silver carp mucus was obtained from Hart Creek, Missouri. Three concentrations of the mucus with deionized (DI) water were prepared and tested. All concentrations were tested at the same temperature as Hart Creek, 22 o C, on a DHR-2 Rheometer using a Peltier Plate and 1o, 40 mm diameter cone geometry. One of the main objectives of the experiment is the determination of yield stress of the mucus. The yield stress of a complex structured fluid is attributed to the minimum shear stress required to initiate flow. It is defined as the applied stress at which irreversible plastic deformation is first observed across the sample. Currently the most utilized rheological phenomenon is the dramatically shear-thinning 'yield-stress fluid,' the reversible transition from solid-like to liquid-like behavior at a critical applied stress). Results of the oscillatory tests reflect this yield stress. Ultimately, experiments are aimed at understanding the role of mucus-laden fluid flow through porous GR channels and ultimately, the tremendous success of the silver carp in outcompeting native fish species.

Engineering

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ABSTRACT

P-cycle Design for Elastic Optical Networks

Elastic optical networks (EONs) provide high spectrum utilization efficiency due to flexibility in resource assignment. Survivability is regarded as an important aspect of EONs. Due to fast restoration and high protection efficiency, p-cycle protection is very attractive for EONs. In this project, we propose two novel link-based p-cycle evaluation methods: individual p-cycle selection and p-cycle set selection for EONs. Based on these methods, we proposed Traffic Independent P-cycle Selection and Traffic-Oriented P-cycle Selection for transparent and translucent EONs. Further, we propose p-cycle generation algorithms and Routing and Spectrum Assignment (RSA) algorithms. Simulation results indicate that the proposed algorithms have better performance than commonly used baseline algorithms and algorithms in the literature.

Engineering

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ABSTRACT

Drugs in Drinking Water: An Enhanced Biological Removal through Biofilm Thickness Management for Sustainable Water Reuse Application

The presence of pharmaceuticals in watersheds is of a growing concern, especially when present in drinking water sources. Many studies have confirmed the presence of pharmaceuticals in municipal wastewater effluents, and these have been addressed as a major source of pharmaceuticals in drinking water. Conventional biological treatment facilities cannot remove those pollutants efficiently. Therefore, improving the efficiency of the removal of emerging pollutants like pharmaceuticals by sustainable treatment technologies is an expanding field of research.

In this context, the objective of this research is to investigate the improvement of removal efficiency of targeted pharmaceuticals through biofilm thickness management in drinking water and water reuse system. The primary hypothesis is, management of thick and thin biofilms will allow for increased contaminant removal for all contaminants in a competing system by eliminating the effects of diffusion through a biofilm. Prior to this study, biodegradation of three pharmaceuticals- acetaminophen, ibuprofen, and salicylic acid (major portion of aspirin) were examined by the bacteria from backwash water collected from full-scale biofiltration plant at different seasons. These compounds were chosen due to their predominant occurrence in water bodies, their consideration as micropollutants, and their different water partitioning behavior. Complete removal of salicylic acid is observed in 30 to 60 hours depending on different environmental conditions, while acetaminophen requires 225 hours to achieve greater than 90% removal. Ibuprofen exhibited poor removal efficiencies in the 40% to 50% range after 225 hours depending on different seasons. Followed by the biodegradation experiments, experiments on three different biofilm thickness (50 µm, 100 µm and 200 µm) were conducted at an initial concentration of around 5 mg/L. Per the biofilm thickness experiments, salicylic acid degradation was faster in the thin biofilm scenario as compared to the thick scenario. Unlike salicylic acid degradation, acetaminophen and ibuprofen showed higher degradation rates by the thick biofilms.

The novelty of this research is it has provided the first clues on the general potential for pharmaceuticals degradation under different biofilm thickness. Ongoing research is investigating the impact of degradation rates and biofilm thickness on overall pollutant removal in pilot-scale biofiltration columns to ultimately increase removal efficiencies.

Engineering

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ABSTRACT

The Disparate Impact of Ride Hailing: Algorithmic Bias through Price Discrimination

Algorithmic bias is the systematic preferential or discriminatory treatment of a group of people by an artificial intelligence system. Here, we show that in ride hailing applications algorithmic bias takes the form of price discrimination, where particular demographics are charged differently for rides than others. We use widely accepted statistical and machine learning methods to examine the fairness of ride hailing services in different neighborhoods, with a focus on underserved communities. Our results indicate that while ridesharing applications provide better coverage than traditional taxis, their dynamic fare-pricing disparately impacts underprivileged communities, even after accounting for demand. Our methodology provides a principled way of identifying and addressing algorithmic price discrimination in any context given the observable outcomes of such models.

Engineering

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ABSTRACT

Feature Selection and Classification Method for Lateralization and Localization of Epilepsy Seizure Focus

Nearly one-third of patients with epilepsy still remain refractory to seizures even if treated with the pharmacotherapy that brings remission to the majority. The standard of care to potentially cure drug-resistant epilepsy is often surgical resection. Positron Emission Tomography (PET) has been involved in contributing complementary diagnostic information to the presurgical evaluation, yet the precise localization is still challenging due to its low resolution and lack of anatomic landmarks. Thus, it is worthwhile to examine whether registering the PET images to the anatomic parcellation provided by Magnetic Resonance Imaging (MRI) could lead to a more reliable prediction for the lateralization and localization of the seizure focus.

In this project, our goal is to build up a general, automated diagnostic tool that provides the prediction of seizure focus lateralization and localization (as temporal or extra-temporal). To achieve that, we use Freesurfer software to generate the virtual cortical surface where we applied the region-based study of PET-based on anatomic segmentation of the cortex. We can calculate the rSUV (relative standard uptake value) as the feature value for each segmented region using the PET voxels within it and combine the features from all regions to form a feature map. We applied LASSO (least absolute shrinkage and selection operator), correlation matrix, mutual information, and autoencoder for feature selection and compared them using the receiver operating characteristic curves from the classifier trained by each set of features. Using those results, we chose LASSO as the final feature selector. Then, regarding the lateralization and localization, we trained two sets of Support Vector Machine, K-Nearest Neighbor, and Naïve Bayes classification models using the rSUV from the region-based study as features. Classification accuracy for lateralization (left/right) reached 88.2%, and for localization (temporal/extra-temporal), 91%. The novelty of our work is that it utilizes a machine learning method to model the medical features provided by PET scans to predict the presence of a seizure focus and applies feature selection strategies to the region-based PET analysis.

Engineering

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ABSTRACT

Machine Learning and Extreme Online Narratives: From Hate and Health to the 2020 Elections

Online hate is one of society's most pressing issues. Long-standing prejudices can now be amplified through the instantaneous nature of online social media. Therefore, it is imperative to understand the underlying mechanics of how hate spreads. One facet that is particularly difficult to analyze is how "flavors" of hate spread among different online groups. The sheer volume of new material created daily makes it almost impossible for any human(s) to properly moderate.

Here we use machine learning to attack the problem. Specifically, we use an unsupervised machine learning technique called Latent Dirichlet Allocation (LDA) to capture the emergence and evolution of topics. This can eventually be generalized to yield real-time monitoring across multiple platforms. Our approach identifies topics in posts with a high coherence, meaning the word groupings identified are strongly related according to a statistical scoring approach. We ran the LDA algorithm over a set of 100,000 posts taken from online hate groups and discovered that the posts can be grouped most strongly into a set of 10 topics, based on a coherence score averaged from 10 different trained models. Human inspection of the word distribution making up each grouping showed that they do indeed describe distinct conversation subtopics.

To test the generalizability of our findings, we also ran this algorithm over non-hate groups carrying one of two separate themes: anti-vaccination posts and a collection of posts about Democratic candidates in the 2020 Presidential race. We find that the topic groupings make sense in both cases. For the anti-vaccination posts, there are many fewer topics (anti-vaccination groups are more focused). In the Democrat discussion posts, many topics were discussed among all pages (with a best fit around 13 topics), but within a particular group (e.g. the fan page for Bernie Sanders), fewer topics were discussed (6 topics).

Our results show that the LDA algorithm identifies plausible subtopics within collections of posts from online discussion groups, making it a useful tool for automatically analyzing online discussions. In addition to being able to handle large quantities of data, its results emerge quickly and are based on statistical grouping techniques, instead of relying on a potentially biased and slow human labeling scheme.

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ABSTRACT

Harnessing Wind Energy for Power System Resilience

Large scale blackouts due to natural disasters and cyber-attacks are becoming more commonplace recently. Therefore, it is crucial to develop a coherent restoration methodology to alleviate the impacts of future grid-scale outages. Increasing penetration of renewable energy resources enables a great potential to be harnessed to attain an agile as well as resilient system's response in dealing with the aftermath of high-impact low-probability of different types of events. This research work develops an efficient restoration strategy considering the wind uncertainty and variability to achieve an enhanced grid resilience in response to widespread emergencies. The proposed restoration strategy is formulated as a non-convex joint probabilistic constraints (JPCs) model; then, the problem is reformulated into a tractable mixed-integer linear programming (MILP) problem to be solved by off-the-shelf solvers. The developed strategy is comprehensively tested on the modified IEEE 57-bus test system and the numerical results illustrate the efficiency of the proposed method.

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ABSTRACT

An Ejector-Based Refrigeration System as a Sustainable Solution for Disaster Relief

Natural disaster-prone regions have a concomitant need for preserving essentials such as food, agricultural produce, and medicines. A low-cost, off-grid, ejector-based refrigeration system is being designed to address this scenario, integrating with sources of renewable waste heat and environmentally friendly refrigerants such as CO_2 and Propane. The mechanisms of ejector operation are (i) entrainment between the primary (driving) flow, and the secondary (refrigerant or driven) flow, and (ii) turbulent mixing. The ejector has the design advantage of "no moving parts" unlike conventional turbomachines. A laboratory-scale ejector was designed and fabricated to evaluate the performance characteristics such as thermodynamic efficiency and entrainment ratios. The limiting factors for the coefficient of performance (COP) of the ejector refrigeration systems include (i) the efficiency of the ejector, (ii) choice of a refrigerant that could efficiently absorb evaporator heat and reject it in the condenser and (iii) the thermal energy used to power the ejector. Accordingly, the thermodynamic analysis of the ideal Reverse Carnot refrigeration cycle was performed (using NIST Software: Cycle_D-Hx). The temperature-entropy and the pressure-enthalpy graphs of refrigeration cycles were generated for R134a, CO_2 and propane refrigerants. Input parameters such as the temperature of the evaporator and efficiency of the ejector (compressor) were taken into consideration. The effects of turbulent mixing in the flow fields were evaluated using COMSOL Multiphysics software (version 5.3). This numerical solver is a finite element-based and incorporates high Mach number flows with k-ε turbulence model. Two-dimensional axisymmetric geometry was used in the simulations of turbulent supersonic flow regimes that are produced in the ejector with air as the working fluid. The numerical results of velocity, total pressure distribution, and the turbulent kinetic energy within the mixing region were generated. The purpose of the numerical analyses was to incorporate realistic boundary conditions derived from laboratory-scale ejector experiments and extend them beyond the laboratory conditions. The combination of experimental data from the laboratory-scale ejector, thermodynamic analyses and flow simulations under varying conditions of total pressures and total temperatures, provide realistic design and operational characteristics of the ejector-based refrigeration system. Natural disasters such as hurricanes cause loss of or intermittency in grid-based power systems and create imminent needs of preserving absolute essential food and medicines. The ultimate goal of the ejector refrigeration technology will be to address the needs of disaster-hit regions, especially in the developing world.

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ABSTRACT

Are European Males and African Females Treated Equally? Quantifying Social and Intersection Bias in Pre-trained Language Models

Pre-trained Language Models are widely used in Natural Language Processing tasks. Bias in these Machine Learning systems has aroused the attention of researchers. In this project, we quantify the social bias in these models with their contextual representation, which is their most powerful weapon. Besides the single bias like gender bias, we go further into the field of intersectional bias like the bias between European American Male and African American Female. The quantification method can be extended to all Pre-trained Language Models and their down-stream applications. In the future, we plan to debias the model based on our quantification method.

Engineering

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ABSTRACT

Integrated Operation of Water and Electricity Network Infrastructures

This paper proposes a comprehensive day-ahead optimization framework for joint operation of the interdependent power and water systems. Different from the conventional paradigms where the power and water systems are independently and individually operated by their respective operators, the proposed optimization framework integrates DC Optimal Power Flow (DCOPF) models in power grids with innovative models of the water distribution systems. The non-convex optimization is transformed to a tractable mixed-integer linear programming (MILP) formulation which can be quickly solved by commercial off-the-shelf solvers. The effectiveness of the proposed approach is validated on a three 15-node water distribution systems, operated within the IEEE 9-bus test system. The simulation results demonstrate a significant cost saving that will be achieved using the proposed methodology.

Engineering

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ABSTRACT

Athena: An Improvement over Ballot-by-Ballot Risk Limiting Election Tabulation Audits

We present a new statistical audit for real elections, which considerably improves on the efficiency of current audits. It is being implemented in software for use in pilots in this year's elections.

Election integrity advocates recommend auditing the paper trail of an election to ensure the reported winner really won. A paper trail is more trustworthy than an electronic one because of the susceptibility of computers to hacks and (remote) tampering. Audits sample ballots from the paper trail until there is convincing evidence that the reported winner won. The proposed standard in the literature is a risk-limiting audit (or RLA). The risk of an audit is the chance that, given that the reported outcome of an election is incorrect, the audit will fail to correct it. Risk-limiting audits ensure that the risk is lower than some pre-specified bound, the risk limit.

All existing audits assume the auditor samples ballot-by-ballot and the audit software determines whether the audit should stop after each ballot draw. The stopping rules are designed to obtain the most efficient audits (in terms of expected number of ballots drawn) for the given assumptions. In practice, however, the determination is not made after each ballot drawn; rather, ballots are drawn in rounds of, say, hundreds. Because more ballots are used to make decisions, the probability of error could be lower than in ballot-by-ballot decisions.

We propose a new type of RLA, Athena, which increases the efficiency of audits (reducing the expected number of ballots drawn by as much as fifty percent) by computing the audit round-by-round. Athena still offers the flexibility that the existing theoretical framework provides, notably that the auditors are free to choose round sizes dynamically. We have developed software to explore the quantitative ramifications of this exciting new type of audit, especially through the lens of stopping probabilities and quantiles, which are important statistical characteristics of audits that provide a means of comparison between them. Athena also can account for the real-world constraints inherent to election audits; we are exploring making allowances for maximum ballots auditors are willing to draw. Moreover, extensive simulations have been conducted to exhibit Athena's comparative efficiency and satisfaction of the risk limit.

Engineering

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ABSTRACT

Capacitive Power Processing Unit: Using Capacitive Energy Storage To Increase Micro-Cathode Arc Thruster Scalability In Cubesats

CubeSats have been gaining popularity in the satellite industry due to their low price, ease of design due to standardization, and ability to accomplish increasingly complex tasks especially when deployed in a fleet. As CubeSats are developed to host a number of intricate scientific and technology-based missions, parameters like subsystem weight and volume can become limiting factors. GWU's Micro Propulsion and Nanotechnology Lab has developed and flight-tested several variations of vacuum arc thrusters including the Micro-Cathode Arc Thruster (μCAT). These thrusters utilize a Power Processing Unit (PPU), which acts as a DC to HVDC converter and allows for the generation of plasma and arc discharge between thruster anode and cathode, resulting in thrust on the order of micronewtons. The PPU makes up the overwhelming majority (~90%) of a thruster subsystem's weight, with the heaviest component within the PPU being a ferrite-core inductor. Because of its weight and the fact that each thruster requires its own PPU to operate, the PPU limits the scalability of integration of μCATs in CubeSats.

The Capacitive Power Processing Unit (CPPU) is a modified version of the PPU aimed at addressing this scalability issue and increasing the functionality of μCATs in CubeSats. The CPPU utilizes capacitive energy storage to reduce the number of ferrite-core inductors used and significantly reduce the weight of the thruster subsystem without greatly sacrificing thruster performance. Transient analysis of the performance of circuit components, optimization of energy exchange efficiency, total power consumption, and overall weight of the PPU and CPPU will be presented and compared. Experimental thrust tests will be performed in a vacuum chamber with a pressure of ~10e-5 Torr, utilizing a thrust stand and Matrix Arc Thruster (a modified μCAT), and will be used to compare the thrust to power ratio of the PPU to the CPPU.

Engineering

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ABSTRACT

CyberGraph: A Cyber Threat Detection System Powered by Graph AI

Computer networks are constantly under a myriad of cyber attacks ranging from high-level government-sponsored operations, down to low-level cyber vandalism. According to the 2019 FireEye M-Trends report, the median time to detection of a computer network intrusion was 78 days. This means an adversary could have over 2 months inside an environment to accomplish their mission prior to detection. Additionally, nearly half of all compromises are detected via external sources, indicating that the tools currently employed by cyber defenders are insufficient to detect advanced adversaries inside their network.

CyberGraph is a defensive cyber-security application which provides robust behavioral analytics to better detect bad actors inside a computer network. This is accomplished in two ways. First, we treat graphs as first-class citizens in our system. We exploit the fact that cyber data is inherently relational, and build a novel data model that allows us to represent cyber knowledge in the form of a graph structure, as opposed to the row or columnar representations utilized by traditional approaches. Second, we exploit recent advancements in Graph AI to build algorithms capable of learning latent patterns of interaction between the elements in the CyberGraph. These patterns of interaction can be used to improve the situational awareness of the cyber defenders, as well as for automated detection of anomalous behavior indicative of malicious activity. Our system utilizes industry standard network logs and can learn and adapt to new environments, rendering it a generalizable and scalable solution in real-world computer networks.

Environmental and Occupational Health

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ABSTRACT

Advancing Health Equity: 21st Century Technology-based Occupational Health Surveillance

There were roughly 3 million on-the-job injuries reported by private industry in 2018, the latest such figure available. However, decades of research suggest this number is grossly underreported. Despite the advances in injury surveillance systems over the years, underreporting of worker injuries is one of the persistent challenges for occupational health and safety professionals. There are several reasons why this underreporting exists. These include complicated system of reporting injuries to the Occupational Safety and Health Administration, fear of retaliation by the employer, and a lack of reporting by the employers themselves. Moreover, proper governance of surveillance systems is a key social determinant of health for worker safety and well being.

To tackle this challenge, we propose a simple solution, albeit not perfect, to this chronic issue: SafetyFirst app. 80% of Americans own and use smartphones. This app will be available in both iPhone and Android formats, free of cost to all American workers. It will make worker injury reporting more streamlined and accessible. Currently, no phone-based app exist that combines these resources.

Some of the key features of the app include; a phone-based OSHA Injury Reporting; Phone-based OSHA Whistleblower's Complaint; Pro Bono Attorney Consultation through the American Bar Association Database (Location-based feature); American Civil Liberties Union Contact (Local Chapter); Multiple Languages (English+ Spanish, initially); Worker Safety Educational Resources/Instructions. This app will exponentially increase injury reporting and add to much-needed evidence to advocate for safe workplaces across the country and advance worker justice.

Environmental and Occupational Health

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ABSTRACT

Dermal Exposure to Silver Nanoparticles and Hepatotoxicity in Laboratory Mammals: A Systematic Review

Silver nanoparticles are commercially available in many dermal-contact consumer products; however, little is known about their potential toxicity. Previous studies have shown that silver nanoparticles are distributed to the liver following oral, inhalation, and intraperitoneal exposure and may lead to hepatotoxic effects. I conducted a systematic review, following the methods and principles of the Navigation Guide, to investigate whether dermal exposure to silver nanoparticles is associated with signs of hepatotoxicity in laboratory mammals compared to sham-treated control animals. A total of six studies were identified and reviewed. Some studies tested multiple nanoparticle sizes or multiple exposure periods, for a total of ten unique experiments. Ultimately, the body of evidence was determined to have inadequate evidence of toxicity due to the fact that many of the studies failed to report quantitative measures of toxicity. Because of this, the magnitude and direction of an effect could not be evaluated. While the studies assessed in this systematic review may hint at the possibility hepatotoxicity, more research with robust results reporting is required to truly evaluate whether an association between dermal exposure to silver nanoparticles and hepatotoxicity exists.

Environmental and Occupational Health

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ABSTRACT

Making Children's Participation in Artisanal Gold Mining a Global Public Health Priority

Children are involved in many aspects of artisanal gold mining (AGM) in Asia, Africa, and South America and there are many barriers to reducing participation in this hazardous work. Estimates of children mining gold (and other minerals) vary widely, with a range from 1.5 to 4.0 million globally. AGM appears to be responsible for as much as 25% of the world's supply of gold. Our aim is to discuss the policy gaps preventing children from ages 6 to 16 from entering this dangerous profession.

Using the published literature, UN agency reports, and exploration of nongovernmental organization (NGO) work (such as that undertaken by Human Rights Watch in Philippines), we sought information on the following: children's populations at risk for AGM, the financial picture of AGM extraction, chronicling and quantifying the workplace hazards for children, assessing mercury (Hg) exposures and clinical outcomes, other pediatric health research on injury and pulmonary effects, and policy initiatives. We developed a short questionnaire that was designed to contrast the responses between citizens in India and the U.S. Gold jewelry and religious objects are more common in Indian households than in U.S. We sought information about children's health and involvement in informal, artisanal gold mining (AGM).

Although there appears to be some awareness of the dangers of having children engaged in AGM, we know gold mining is one means for impoverished families to provide income. However, we also found there is little or no governmental policy incentives to encourage children to attend school; there is no process to educate mine families about Hg, silica or lead (Pb) dust, no samples of air, water or soils for guidance to degree of hazard; and no effective certification to show a reduction or elimination of children's mine work. Lastly, there is very little published information regarding health effect studies to share with mining communities focusing on Hg or Pb contamination, mine injury risks, other types of poisoning such as arsenic. Health effects should include accidental injuries, respiratory function, dermal assessment, and neurological assessments.

Environmental and Occupational Health

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David Michaels

ABSTRACT

The Effect of Occupational Exposure to Wildland Fire Smoke on Pulmonary Function: A Systematic Review of Human Evidence

Twice the area is being burnt by wildfires today than it used to in 1980s and 1990s. Climate change has a profound impact on the occurrence and frequency of wildfires in a variety of ways. The group of population most affected by these wildfires remain to be wildland firefighters who work tirelessly around the clock with little to no downtime. Evidence has reported rate of decline in lung function in wildland firefighters. Despite the known occupational hazards, it is not clear whether long-term firefighting in wildlands leads to a greater rate of decline than would be normally expected, and how this rate is affected by other risk/protective factors.

The Navigation Guide systematic review methodology was used to determine whether there is a rate of change of lung function in wildland firefighters after exposure to wildland fire smoke. The Navigation Guide is a systematic and transparent method for synthesizing environmental health research from multiple evidence streams. The first 3 steps of the Navigation Guide methodology were applied to human data: 1) specify the study question, 2) select the evidence, and 3) rate the quality and strength of the evidence. To conduct a comprehensive and replicable search of the literature a search protocol was developed to identify relevant studies using specific inclusion criteria. Each study was assessed for risk of bias and then the overall quality and strength of the body of evidence was determined.

The search resulted in 59 unique studies, 10 of those studies me t the inclusion criteria. The risk of bias across studies was "low" to "probably low", but the overall quality of evidence was given a "low" rating due to inconsistency and imprecision across the body of evidence. Among firefighters exposed to wildland firefighting, the reported results of change in lung function were variable with respect to FVC and ranged from normal rates of decline to what could be considered accelerated and consistent with respect to FEV1.

Based on our analysis and interpretation of the evidence, we concluded that the available evidence is "limited" to assess effects because of limited size of studies and because of its homogeneity and lack of generalizability and low to moderate quality of individual studies.

Environmental and Occupational Health

Milken Institute School of Public Health

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ABSTRACT

Effects of Pesticide Exposure and Body Size on Endometrial Cancer Risk Among Spouses of Pesticide Applicators in the Agricultural Health Study

Endometrial cancer is the most commonly diagnosed tumor of the female genital tract, and incidence in the US has been increasing. Women who live and work on farms have higher endometrial cancer risk compared to the general population. These women are likely to experience high exposure to a variety of pesticides, many of which have endocrine-disrupting properties. We used data from the Agricultural Health Study (AHS) cohort to conduct the first study comprehensively evaluating self-reported pesticide use and endometrial cancer risk.

The prospective AHS cohort includes 32,345 spouses of pesticide applicators (mostly women) who live and work on farms in Iowa (IA) and North Carolina (NC). We evaluated the association between ever use of specific pesticides (10 pesticides with ≥15 exposed cases) reported at study enrollment (1993-1997) and incident endometrial cancers diagnosed through 2016(NC)/2017(IA). We estimated hazard ratios (HRs) and 95% confidence intervals (CIs) using Cox proportional hazards models, adjusted for age, state, body mass index, smoking status, race, and reproductive factors.

Of the 25,732 AHS women included in our analysis (excluding those with prevalent cancer or hysterectomy at enrollment), 420 were diagnosed with incident endometrial cancer and 49.7% reported personal use of pesticides. At study enrollment, women who were diagnosed with endometrial cancer were more likely to be older, reside in Iowa, never smoked, and had higher body mass index. Glyphosate (HR=1.16, 95%CI:0.94-1.43), 2,4-D (HR=1.18, 95%CI:0.90-1.55), petroleum distillates (HR=1.41, 95%CI:0.87-2.24), and malathion (HR=1.13, 95%CI:0.89-1.45) were associated with suggestive increased risk of endometrial cancer; none of these associations reached statistical significance.

In a prospective cohort of women living and working on farms, we found limited evidence that pesticides are associated with endometrial cancer risk. Suggestive positive associations with specific chemicals may indicate a role in the etiology of hormonally related cancers, though additional work is needed to confirm these associations. Molecular epidemiologic studies may further elucidate potential mechanisms related to endocrine disruption.

Environmental and Occupational Health

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Matias Attene Ramos

ABSTRACT

Evaluation of the Reproductive Toxicity of Boric Acid: A Systematic Review

Boric acid is a metalloid that can be found in the body and is likely an essential human nutrient. At high concentrations consequential reproductive effects have been seen in animal studies, but this evidence conflicts with recent human studies where no such effects were observed. A systematic review was done using the navigation guide to evaluate the body of evidence that exists thus far and determine if there is enough evidence to classify boric acid as a reproductive toxin. It was determined that there is a lack of adequate evidence in the human and animal data to determine the toxicity of boric acid. More research should be done to close the existing knowledge gaps because boric acid is used in a lot of products used daily and poses a risk to people who use these products. There should also be more funding allocated to research in understanding the differences between animals in humans in chemical testing. This is the standard method for these types of test and until we can transition to an alternative testing system, we need to be confident in combining the pool of literature to get a more complete picture.

Environmental and Occupational Health

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ABSTRACT

Do Microplastics Size 1-10 µm Have Adverse Health Effects On Daphnia Magna? A Systematic Review

Microplastics are pollutants increasingly found in our environment and there is controversy as to their health effects on livings organisms.

The Navigation Guide systematic review method was applied to answer the question "Do microplastics size 1-10 µm have adverse health effects on Daphnia magna?"

A comprehensive search of literature was conducted with prespecified search terms. A risk of bias analysis for individual studies was evaluated and the overall quality and strength of the evidence was evaluated.

Six studies met the inclusion criteria. The rating for bias was generally "low" to "probably high" risk of bias, while the overall quality of evidence was rated as "low" with "limited" evidence for an association between microplastics and the outcomes of mortality, growth, and reproduction in Daphnia magna. Although, quality was low there is a trend in a decline in reproduction compared to controls. Mortality was not highly affected; increased changes were noticed only after the 21-day OECD toxicity testing guideline. Mixed results were found in studies evaluating the effect of microplastics on growth.

There was limited evidence that microplastics size 1-10 µm have adverse health effects on Daphnia magna. More research is needed to understand the relationship between microplastics and Daphnia magna.

Environmental and Occupational Health

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ABSTRACT

A Systematic Review of Incidence of Acute Myocardial Infarctions Among Coastal Communities Before and After Hurricane Landfall

As climate change continues to influence the frequency and intensity of cyclonic storms, the impact of hurricanes on coastal communities is increasing, leading to growing financial and human costs. Cardiovascular events are shown to be associated with stressful events such as natural disasters and have been shown to increase after earthquakes. To better understand the impact these hurricanes will have on the health of coastal communities, a systematic review of the literature was carried out examining the relationship between hurricanes and cardiovascular events among adults living in coastal areas.

The process for this review was outlined by the Navigation Guide. We performed a systematic search of epidemiology literature and identified distinct criteria used to determine which studies would be included. Each study was rated for risk of bias and examined for quality and strength of evidence before coming to a determination of the overall quality and strength of the evidence.

We identified 6 cross-sectional epidemiological studies published in peer-reviewed journals that met the inclusion criteria. Four of the five studies focused on Hurricane Katrina while the fifth focused on Hurricane Sandy. We rated the current body of evidence to be of moderate to low quality.

While individuals studies show a strong association between hurricanes and increased incidence of cardiovascular events, the body of evidence is not robust enough to assume generalizability of the results. More research needs to be done in order to better understand the relationship between hurricanes and incidence of cardiac events.

Environmental and Occupational Health

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ABSTRACT

Nature and Well-Being: Estimating the Effects of Exposure to Green Space on Health Disparities across Washington, DC

Expanding green space area and access can help mitigate climate change and improve public health in urban settings. Green space, traditionally defined as undeveloped land with natural vegetation, also includes a broader range of urban features such as urban parks, public urban spaces, street trees, and greenery. Previous meta-analyses of epidemiological studies have demonstrated that increased exposure to green space improves health outcomes and life expectancy by increasing physical activity, improving mental health, reducing stress, and lowering cardiovascular mortality and all-cause mortality. Washington, DC, has a large degree of environmental and health inequality, with life expectancy ranging 21 years across the neighborhoods at the two ends of the spectrum, for example.

The objective of this study is to assess current neighborhood-level disparities in exposure to green space, as well as the differences in associated health impacts, across Washington, DC.

We utilize green space databases — including DC Geographic Information System (DC GIS), AtlasPlus, and ArcGIS — to estimate exposure to green space across DC neighborhoods. We estimate associated health impacts using exposure-response relationships from epidemiological meta-analyses, and life expectancy and physical activity, mapped by neighborhood and ward in the District of Columbia 2018 Health Equity Report.

Results will include quantitative estimates of the degree of population exposure to green space and associated health impacts across DC neighborhoods. These baseline estimates can be used in the future to estimate the health benefits of expanding green space area and access in the future.

Results of our study will be communicated with Sustainable DC and the DC Office of Health Equity. In addition, results will provide a foundation for integrating the health impacts of green space into urban climate action planning organized by C40 Cities. Understanding the public health benefits of exposure to green space in cities will help local policymakers understand the local improvements in public health and health inequality that can be achieved via urban sustainability and climate action planning.

Environmental and Occupational Health

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David Michaels

ABSTRACT

Systematic Review of Childhood PBDE Exposure and Thyroid Hormones

Animal and some human studies have suggested that exposure to polybrominated diphenyl ethers (PBDEs) may affect the normal production and movement of thyroid hormones, especially for fetuses and young children. These findings are not without controversy, as the conclusions have not been consistent to date. The objective of this systematic review is to determine if there is an association between childhood exposure to PBDE and alteration of thyroid hormones, if so what is the magnitude and direction of this effect.

Medical and scientific literature databases were searched for articles that met the eligibility criteria. Articles that passed the initial screening were then evaluated through full text review. Changes to TSH, T3, or T4 must have been measured for an article to be included. The included studies were assessed for quality and strength of evidence.

There was limited evidence of an association between PBDE exposure and disruption of normal thyroid hormone processes. This conclusion that the human data were limited was based on "moderate" quality evidence, the inconsistency of findings across individual studies, and confidence that new studies could change the observed effect. Three studies showed no statistically significant association between PBDE and thyroid hormones, while the others showed varying degrees of positive and inverse relationships with adequate confidence bounds.

Results from this systematic review show that PBDE exposure may be linked to hypothyroidism and hyperthyroidism, two conditions that form from irregular distribution of thyroid hormones. The significance of adverse health outcomes may be dependent on a variety of factors such as serum levels, race, gender, and iodine nutrition. Future studies should assess the impact of this exposure through stratifying by age and gender. Longitudinal studies that examine hyper and hypothyroidism's relationship with PBDE needs more research.

Environmental and Occupational Health

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ABSTRACT

Cardiovascular Disease and Crude Oil Exposure: A Systematic Review

We utilized the methodology provided in the Navigation Guide to conduct a systematic review that answers the research question "Does crude oil exposure increase the incidence of heart attacks and CHD among oil spill exposed individuals?" and assess the strength of evidence across studies.

Our literature search included potential studies for inclusion using previously supported methodology, examined studies for exposure and outcome relationships, and performed an analysis addressing risk of bias, strength of evidence, and quality of evidence across the literature base.

Five studies fulfilled the inclusion criteria for review. The evidence provided suggests associations between cardiovascular outcomes and crude oil related exposures. Overall, the quality and strength of evidence across studies was rated as "moderate" and "limited," respectively.

In accordance with current Navigation Guide criteria, we found "limited" evidence that crude oil exposures increase the risk of cardiovascular outcomes. Future studies should continue to examine relationships between oil exposures and heart disease, specifically hypertension and myocardial infarction.

Environmental and Occupational Health

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ABSTRACT

Assessing Needs and Addressing Climate Change at Grand Rounds and Pre-clinical Curriculum: Knowledge, Attitudes, and Engagement

Global climate change is described as the "greatest threat to global health in the 21st century" and as a threat that will profoundly affect "[t]he life of every child born today." Academic medical centers will play a critical role in equipping clinicians to care for patients in a changing climate. The World Health Organization asserts healthcare professionals "have a duty of care to current future generations" in the face of global climate change. However, standard medical school curricula do not include this topic. The George Washington University School of Medicine and Health Sciences Internal Medicine Grand Rounds and the pre-clinical Patients, Populations, and Systems (PPS) course both offer opportunities to incorporate foundational climate change education to engage varied audiences at different stages of training and experience.

The "Global Climate Change: Understanding and Responding to Impacts on Health" lecture provided an overview of climate science, a review of diseases with environmental drivers and how climate change impacts health, populations facing disproportionate risk. This lecture was given at Grand Rounds to 38 physicians and to 85 second year medical students in the PPS course. Both groups completed a pre-lecture survey to evaluate baseline perceptions of climate change and its impacts on health.

87% of participants from Grand Rounds identified the issue of climate change as "extremely important" or "very important" and 76% identified being "very worried" about climate change. Among medical students, 73% identified climate change as "extremely important" or "very important" and 49% identified being "very worried" about climate change. Nearly all participants (95% and 87% from Grand Rounds and PPS respectively) agreed climate change will affect future generations "a great deal." Yet only 13% and 8% of Grand Rounds and PPS participants, respectively, felt "very knowledgeable" about the impact of climate change on health, with 32% of Grand Rounds participants and 27% of PPS participants agreeing it is directly related to patient care "a great deal."

Epidemiology and Biostatistics

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ABSTRACT

Evaluating the Patient Barriers to Isotretinoin Treatment for Acne Vulgaris

Isotretinoin is the standard treatment for severe, nodulocystic, recalcitrant acne. Due to the teratogenic effects of isotretinoin, iPLEDGE was developed by the FDA with the goal to prevent pregnancies while taking isotretinoin. Despite these goals, studies find no change in pregnancy rate and report that iPLEDGE may promote healthcare disparities. This system is particularly onerous to female patients who must complete the following steps monthly to receive their medication: (1) register with iPLEDGE; (2) undergo two negative pregnancy tests prior to initiation; (3) confirm the use of two forms of contraception; (4) take a quiz in iPLEDGE; (5) see their provider for counseling and confirmation in iPLEDGE. Once the patient's pregnancy test is recorded into iPLEDGE, a 7-day window period is initiated during which the patient must retrieve their monthly supply of isotretinoin from a pharmacy. Failure to do so may result in being locked out of the system or require a repeat pregnancy test. The purpose of this cross-sectional study is to evaluate the characteristics of the patients that miss window periods, have gaps in treatment, and/or terminate treatment early and summarize the most common reasons for these occurrences. Patient data on many variables was extracted from electronic medical records for all patients younger than 21 years old receiving isotretinoin for the treatment of acne vulgaris from 2010-2019 at the Children's National Hospital. The outcome of interest is the completion of the isotretinoin course of treatment. Several exposures were examined. 162 patients were included in the study: 103 males, 59 females. The average length of treatment for males was 198 days ± 114, for females was 170 days ± 104. 19% of female patients and 3% of male patients missed the window period at least once. Treatment was delayed due to insurance processing for females at 22%, males at 5.1%, due to iPLEDGE processing for females at 20%, males at 2.5%, due to pharmacy processing at 13% for females, 3.8% for males. For all patients with early termination of treatment, the most common reasons included loss to follow-up (66%), side effects (11%), and other (9.2%). Identifying the reasons for delays or interruptions in treatment can allow reformation of healthcare policies and allow patients to get needed medication.

Epidemiology and Biostatistics

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ABSTRACT

The Impact of Glycemic Control on CD4 Cell Count in Persons Living with HIV and Diabetes Mellitus Washington, DC.

Among persons living with HIV (PLWH) with type 2 diabetes mellitus (DM) there is limited research on the effect of DM control on CD4 count. Current guidelines recommend that PLWH with DM maintain a hemoglobin A1c (HbA1c) <7%. This analysis examined the impact of HbA1c on trends in CD4 count among PLWH receiving care in Washington, DC.

We used data from the DC Cohort, a longitudinal observational cohort of patients receiving HIV care at 14 clinics between 2011-2018. Participants with DM on an ongoing antiretroviral regimen with ≥1 year of follow-up, ≥2 HbA1c results, and ≥2 CD4 count results were included. Participants were compared based on the most recent HbA1c result categorized into one of three control levels control: strict, HbA1c <7.5%; moderate, HbA1c between 7.5-9.0%; and uncontrolled, HbA1c >9.0%. All statistical tests were performed within the framework of the linear mixed effects (LME) model. The rates of increase in CD4 count by DM control were compared using a LME model with random slopes and random intercepts, adjusted for sex, BMI, nadir CD4, a history of AIDS, or cancer diagnosis.

Among 554 participants (median age 53.5; 70.8% male; 82.7% Black), there were 5,138 total CD4 count measurements. In unadjusted analysis, participants with moderate or uncontrolled HbA1c had higher mean CD4 counts over the follow-up period than those with strict HbA1c control (strict: 690 cells/μL, moderate: 712 cells/μL uncontrolled: 711 cells/μL; p=0.0156 strict vs. moderate, 0.049 strict vs. uncontrolled). All DM control groups had a similar temporal increase over time in CD4 count (p=0.46). In multivariate analysis, only moderate vs. strict control showed a significant difference in CD4 count (mean difference=18.1; p=0.02). Results showed CD4 count change was not affected by duration of HIV diagnosis or diabetes diagnosis. See Table 1 for additional results.

PLWH and DM with moderate HbA1c control had higher CD4 counts than those with strict HbA1c control and similar CD4 counts compared to those with uncontrolled HbA1c levels, while the rate of increase in CD4 count was similar in the three groups. These results show that moderate DM control may benefit CD4 count, which should be considered when revising DM control guidelines for PLWH.

Epidemiology and Biostatistics

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ABSTRACT

Investigating Molecular and Metabolic Pathway Activities in Roux-en-Y Gastric Bypass Using Omics Enrichment Analyses

Characterizing the molecular activities underlying biological processes is critical to understanding human health. In this work, we use Roux-en-Y gastric bypass (RYGB), a surgery-based treatment resulting in rapid weight loss and reduced adiposity, in a rat model to investigate the metabolite changes due to RYGB. In addition to calorie restriction and malabsorption, metabolic improvements have been reported to contribute to RYGB-associated weight loss. Recent efforts have shown that genes involved with metabolic pathways are differentially expressed in mice and humans who have gone through gastric bypass. Furthermore, RYGB-altered microbial communities have been associated with the improvement of metabolism.

Given the mechanism behind the metabolic outcome of RYGB recipients is not clear, our goal is to investigate the change in metabolic status after RYGB treatment with extensive controls (RYGB, sham, and weight-matched rats) for surgery and diet over the course of three months (sample collection at 1 week, 1 month, and 3 months). Plasma samples were collected and processed to generate LC-MS metabolomic and proteomic profiles. RYGB rats had a significantly different metabolite profile compared to weight-matched or sham rats. To study the effect of RYGB on metabolic pathways, our lab has developed deepath, an enrichment analysis tool, to identify the significantly enriched pathways in RYGB rats through assessment of the metabolomics profiles.

Our enrichment analysis indicated that gastric bypass modifies the metabolite pathways in a time-dependent manner. When comparing RYGB to weight-matched rats, the acute effect of RYGB is causing a decrease in steroidogenesis and linoleic acid metabolism, while the long term effect is inhibiting the Warburg effect and citric acid pathways. Given that heat production and respiratory exchange rates have been found to be altered in RYGB mice, the change of these metabolite pathways may help to understand the metabolic improvement observed after RYGB.

Epidemiology and Biostatistics

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ABSTRACT

The Association between Swine Exposure and Community-Acquired Methicillin-Resistant Staphylococcus Aureus in North Carolina

Methicillin-Resistant Staphylococcus aureus (MRSA) is a type of bacterial infection predominately seen in healthcare settings. However, as infection control practices in healthcare settings have improved, research has indicated a shift from Hospital Acquired MRSA (HA- MRSA) infections to Community-Acquired MRSA (CA-MRSA) infections. Large-scale industrial swine facilities are potential reservoirs for MRSA bacteria in the community.

The objective of this study is to evaluate the association between patients hospitalized with a MRSA infection and their residential proximity to counties containing a swine Concentrated Animal Feeding Operation (CAFO) within the state of North Carolina. Additionally, the research examines the number of swine in each county to determine whether an increase or decrease could affect the rates of CA-MRSA in the community.

Data was obtained from the North Carolina (NC) Hospital Discharge Database on all inpatient hospitalizations with a primary diagnosis of MRSA in fiscal years 2015, 2016, and 2017. The cases were categorized into HA-MRSA or CA-MRSA groups and logistic regressions were conducted to determine associations between the case's exposure to swine facilities and their MRSA infection. Exposures were determined using the North Carolina Agricultural Statistics report on the USDA website and cross-referencing the list of permitted animal facilities on the NC Department of Health and Human Services website to determine the county of the swine facilities and number of swine in those counties.

For every increase in the ratio of swine to people per county, the adjusted odds ratio (aOR) for CA-MRSA cases decreases and HA-MRSA increases. For cases who lived in a county with a swine CAFO the probability of a CA-MRSA infection was 72.5% lower than for those who do not live in a county with a swine CAFO (95% CI 0.635 – 0.828). For cases who lived in a county with a swine CAFO the probability of an HA-MRSA infection was 33.6% higher than those who did not live in a county with a swine CAFO.

This inpatient hospital data demonstrated novel results regarding a positive association between HA-MRSA and swine exposure. Limitations of this data indicate a need for further research and further refinement of methods. Future research should further adjust for exposure, analyze whether an adjustment should be made to the definition for HA-MRSA, and consider adding colonizing cases and cases without MRSA to the analysis.

Epidemiology and Biostatistics

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ABSTRACT

HAPHPIPE: Haplotype Reconstruction and Phylodynamics for Deep Sequencing of Intra-Host Viral Populations

Deep sequencing of viral populations using next generation sequencing (NGS) offers opportunities to better understand and investigate evolution, transmission dynamics, and population genetics. Currently, the standard practice for processing viral NGS data is to summarize all the observed sequences from a sample as a single consensus sequence, thus discarding valuable information about the intra-host viral molecular epidemiology. Furthermore, existing analytical pipelines may only analyze genomic regions involved in drug resistance, thus are not suited for full viral genome analysis. Here we present the development and validation of HAPHPIPE, a HAplotype and PHylodynamics PIPEline for genome-wide assembly of viral consensus sequences and haplotypes. HAPHPIPE is designed to provide users with a single pipeline to rapidly analyze sequences from viral populations generated from NGS platforms and provide quality output properly formatted for downstream evolutionary analyses, in particular phylodynamics. To validate HAPHPIPE in comparison to currently available pipelines, we compared the performance of the consensus sequence construction methods of HAPHPIPE with those of HyDRA (free web-based) and Geneious (proprietary) platforms on simulated HIV-1 data and empirical HIV-1 and HCV data. We found that NGS viral analysis is improved with the use of HAPHPIPE compared to generating consensus sequences with HyDRA and comparable to those sequences created in Geneious. Furthermore, using de novo assembly compared to reference-based assembly, regardless of the iterative refinement of the consensus sequences steps or tool, generates a consensus sequence that is closer to the true sequence.

Epidemiology and Biostatistics

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ABSTRACT

The Impact of Long-term Corticosteroid Use on Acute Postoperative Complications Following Lumbar Decompression Surgery

Corticosteroids have a negative impact on the human immune system's ability to function at an optimal level. Prior studies have shown that patients on long-term corticosteroids have higher infection rates. However, the rates of infection and other complications following lumbar decompression surgery remains under-investigated. The aim of our study was to determine the impact of preoperative long-term corticosteroid usage on acute, 30-day postoperative complications in a subset of patients undergoing lumbar spine decompression surgery, without fusion or instrumentation. We hypothesize that patients on long-term corticosteroids will have higher rates of infection and other postoperative complications after undergoing lumbar decompression surgery of the spine.

A retrospective cohort study was conducted using data collected from the ACS National Surgical Quality Improvement Program database data from 2005-2016. Lumbar decompression surgeries were identified using CPT codes. Chi-square analysis was used to evaluate differences among the corticosteroid and non-corticosteroid groups for demographics, preoperative comorbidities, and postoperative complications. Logistic regression analysis was done to determine if long-term corticosteroid use predicts incidence of postoperative infections following adjustment.

26,734 subjects met inclusion criteria. 1,044 patients (3.9%) were on long-term corticosteroids prior to surgical intervention, and 25,690 patients (96.1%) were not on long-term corticosteroids. Patients who were on long-term corticosteroids were more likely to be older ($p < 0.001$), female ($p < 0.001$), nonsmokers ($p < 0.001$), and have a higher American Society of Anesthesiologist class ($p < 0.001$). Multivariate analysis demonstrated that long-term corticosteroid usage was associated with increased overall complications (odds ratio [OR]: 1.543; $p < 0.001$), and an independent risk factor for the development of minor complications (OR: 1.808; $p < 0.001$), urinary tract infection (OR: 2.033; $p = 0.002$), extended length of stay (OR: 1.244; $p = 0.039$), thromboembolic complications (OR: 1.919; $p = 0.023$), and sepsis complications (OR: 2.032; $p = 0.024$).

Exercise and Nutrition Sciences

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ABSTRACT

Pilot Testing of the Choose Health: Food, Fun, and Fitness Lessons Curriculum with 9-13-Year-Old Underserved Youth

In the U.S., 15.3% of children ages 10-17 are obese. Obesity increases the risk for well-known chronic diseases (i.e. diabetes, hypertension). Proper nutrition is key in preventing obesity. Children exceed recommended daily adequate intake of sodium and added sugars while failing to meet guidelines for fruit and vegetable intake. After-school programs provide an ideal setting to continue children's education and teach additional life skills, such as healthy eating behaviors. The aim of this project is to pilot test the Choose Health: Food, Fun, and Fitness (CHFFF), an experiential learning curriculum that teaches children healthy eating and active play, with a sample of 9-13 year-old underserved youth to evaluate its performance in increasing nutrition knowledge (pre to post test). In addition, the CHFFF will be evaluated to assess children's acceptability of the lessons.

A sample of 40 children aged 9-13 years enrolled in an afterschool program at the Rita Bright Youth Center in Washington D.C. will participate in the pilot testing. Children will receive a one-hour lesson, once a week on four nutrition topics: avoiding sugar-sweetened beverages, the importance of eating fruits and vegetables, healthy alternatives and options regarding fast food, and the importance of a balanced breakfast. Each lesson consists of an interactive warm up activity, a nutrition lesson, a supplemental activity (i.e. measuring the amount of sugar in popular drinks), and a recipe preparation with optional tasting. Lessons will be delivered once in the spring and once in the summer 2020. Approximately 15-20 children will participate in each cohort. Demographic and eating behavior information will be collected via questionnaire at baseline. A nutrition knowledge questionnaire will be administered before lesson one (pre test) and after completion of lesson four (post test). To evaluate curriculum acceptability, educators will conduct a group conversation with children at the end of lesson four. Educators will discuss lesson delivery performance after each lesson. Descriptive data will be computed for children's demographic and eating behaviors (i.e. children's food preferences during independent eating occasions), and children's responses to the acceptability to the lesson questions. Pre to post changes in children's nutrition knowledge will be analyzed using paired t-tests. Findings will inform a culturally-sensitive afterschool program for low-income youth to improve nutrition-related knowledge and behaviors.

Exercise and Nutrition Sciences

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ABSTRACT

Providing Nutrition Education to Low-Income Families in Washington D.C. Ward 7 and 8: Process Evaluation of Nutrition To GO! with Martha's Table Joyful Markets' Customers

All communities deserve equal access to healthy food choices and education to make informed decisions on foods choices. In the District of Columbia, residents of Wards 7 and 8 live in "food desserts" and lack exposure to nutrition education. Martha's Table, a non-profit organization, in partnership with D.C. Health SNAP-Ed and Capital Area Food Bank provides fresh produce to low-income families in Ward 7 and 8 at no cost through the Joyful Food Markets. The markets aim to increase access to and encourage consumption of fresh fruits and vegetables.

Currently, the Joyful Food Markets do not have a nutrition education component. Nutrition To GO!, is an adult nutrition education curriculum that uses interactive displays boards as the basis to deliver quick lessons on healthy eating and resource management (i.e. simple ways to eat more fruits and vegetables , cooking with kids, stretching food dollars). Nutrition to GO! has not been evaluated with low-income, predominantly African-American populations. The purpose of this study is to conduct a process evaluation of four lessons of Nutrition to GO! with adult customers (n=50) of Martha's Table Joyful Food Markets.

Four lessons: "Calories in Beverages," "Cooking with Kids," "Start the Day with Breakfast," and "Simple Ways to Eat More Fruits and Vegetables" will be tested. Lessons will consist of a manned display board with the topic of the lesson, an interactive activity to engage participants, a give-away gift to reinforce the nutrition message, and handouts. It is expected that interaction time between the educator and the participants to be between 5-8 minutes. Lessons will be delivered once a week for up to eight consecutive weeks during the time the Joyful Markets are provided in afterschool programs. The lessons will be evaluated for content and educational material appropriateness by use of short surveys to participants. Change in nutrition knowledge (pre to post-test) will be evaluated to assess curriculum effectiveness.

The study will provide information on the acceptance and effectiveness of Nutrition to GO! lessons with predominately low-income African-American adult customers of Martha's Table Joyful Markets. Findings will inform a community-based nutrition intervention for low-income, urban African-American adults.

Global Health

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ABSTRACT

Endline Evaluation of Integrated WASH and Nutrition Interventions on Child Health in Cambodia

The NOURISH project was a comprehensive social behavior change (SBC) campaign led by Save the Children and in partnership with five national and international partners: Operations Enfants du Cambodge, Partners in Compassion, SNV, The Manoff Group, and Wathnakpheap to promote 13 key stunting prevention behaviors including a mix of health and nutrition, and WASH interventions across all villages in Cambodia. 38 villages were randomly selected to received nutrition only interventions and 77 were randomly selected to receive integrated-nutrition-and-WASH interventions. Data was collected via a cross-sectional survey from 2257 people total, comprised of 405 children 0-5 months, 955 children 6-59 months, 500 women of reproductive age and 397 pregnant women, conducted at study endline in April 2019. At endline, women in villages with a nutrition-only intervention reported 20% prevalence of diarrhea in children 0-59 months within the last two weeks while women in nutrition+WASH villages reported 15% prevalence (RR 0.74, 95% CI 0.54 − 0.99, p = 0.032). The standardized mean difference for weight for height for children 0-59 months was 0.20 (95% CI -0.30 − 0.22, p = 0.031) illustrating that those in the integrated intervention arm were found to have a higher WLZ score. For g/dL hemoglobin (Hgb), the mean difference was 0.20 (95% CI 0.02 − 0.38, p = 0.026) indicating those in the integrated intervention arm were found on average to have higher levels of hemoglobin and less anemic. However, neither intervention arm had significant improvement in health outcomes aside from mothers reporting diarrhea (0.74, 95% CI 0.54-0.99, p = 0.045) for children under five in the last two weeks. The adjusted mean difference for g/dL hemoglobin for women of reproductive age was 0.85 (95% CI 0.20 − 1.49, p = 0.010) indicating there were lower rates of anemia in the integrated intervention arm.

There was no positive impact of the addition of WASH to nutrition programs on stunting, wasting, and minimum acceptable diet for children. For women of reproductive age, there was no significant difference among health indicators including prevalence of underweight, anemic and minimum dietary diversity achievement in women. We also found no difference between the nutrition versus the nutrition+WASH villages when comparing WASH behavior indicators. This is consistent with studies conducted in 2018 that showed little or no impact of selected WASH interventions on children's' health outcomes. The importance of assessing the mechanism by which WASH interventions combat the number one killer of children under five—diarrhea—is highlighted, especially as this decrease does not have a statistically significant positive affect on health outcomes as we would expect.

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ABSTRACT

Most Anemic Women in India Do Not Know They Are Anemic: What Are The Predictors for Knowing One's Status?

Anemia affects over half of women of reproductive age (WRA) in India. Although recent policy changes promote iron supplements to all WRA, the government distributes iron supplements to pregnant women through frontline workers and to adolescent girls through school systems. Non-pregnant out-of-school women must proactively seek iron supplements, but many do not know they are anemic. Thus, demand for iron supplements remains low. The current study investigates the predictors of knowing one is anemic.

We administered a survey as part of the Reduction in Anemia through Normative Innovations (RANI) Project to WRA in Odisha, India. We asked about anemia status, demographics, knowledge, attitudes, and practices around anemia. We also tested for anemia via a hemoglobin test. We used logistic regressions on a sample of anemic WRA (N= 2,604) to analyze predictors of knowing one is anemic.

Approximately 94% of anemic women did not know they were anemic. Those taking iron supplements were more likely to know their anemia status (b=1.42, p=0.001), as were those who had received an anemia diagnosis (b=2.61, $p<.001$), or had strong personal risk perception (b = 0.88, $p<.001$). When this risk was extended to others in their community, the effect disappeared. Lastly, those with lower hemoglobin counts were more likely to know their status (b=-.23, $p<.001$). While age, current marriage or pregnant, anemia-related interpersonal communication, education, and caste are predictors of anemia, they did not predict knowing one's own status. Surprisingly, accurate knowledge about the deficiency was almost completely unrelated to knowing one is anemic.

Iron supplement use is directly linked with knowing one is anemic. Those who had once received a diagnosis, demonstrate strong personal risk perception, or are severely anemic are more likely to know they are anemic. Many interventions aim to increase knowledge about anemia, but this may not propel behavior change when demand is low. Rather, these results suggest that interventions should improve a woman's ability to recognize her susceptibility and understand symptoms when they manifest. One such strategy is to promote community-based hemoglobin testing, which would reduce ambiguity about one's anemia status.

Global Health

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ABSTRACT

Diabetes Specialty Care in a Low Resource Setting: Assessing Factors Associated with Loss to Follow Up

This analysis aimed to quantitatively assess the factors associated with loss to follow up among diabetic patients in an urban, outpatient clinic in Phnom Penh, Cambodia. The Community Medical Clinic (CMC) started its Diabetes Mellitus Program in July 2015 to help its patients, both diagnosed with and at risk of developing diabetes, treat and manage their chronic disease. The program has grown to over 5,765 participants as of January 2020 but almost 40% of patients do not return for a single follow up visit at CMC following enrollment. This limits the doctors' abilities to accurately track each patient's blood glucose (HbA1c) levels and review their medications and potential side effects. A regression analysis was conducted to determine the baseline factors impacting a patient's likelihood of coming back to the clinic for two follow up visits within a year of enrollment in the DM Program.

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ABSTRACT

Endline Evaluation of Integrated WASH and Nutrition Interventions on Child Health in Cambodia

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There was no positive impact of the addition of WASH to nutrition programs on stunting, wasting, and minimum acceptable diet for children. For women of reproductive age, there was no significant difference among health indicators including prevalence of underweight, anemic and minimum dietary diversity achievement in women. We also found no difference between the nutrition versus the nutrition+WASH villages when comparing WASH behavior indicators. This is consistent with studies conducted in 2018 that showed little or no impact of selected WASH interventions on children's' health outcomes. The importance of assessing the mechanism by which WASH interventions combat the number one killer of children under five—diarrhea—is highlighted, especially as this decrease does not have a statistically significant positive affect on health outcomes as we would expect.

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ABSTRACT

Commercial Determinants of Health: Hiding in Plain Sight

In today's age of flourishing direct-to-consumer and social media marketing, the reach and power of corporations is increasing rapidly in high-income countries. Meanwhile, their harmful effects are much more profound in low- and middle-income countries (LMICs) – especially the health risks associated with the production, marketing and consumption of commercially produced products, motor vehicles, food and drink (such as those containing sugar, salt and trans fats), alcohol and tobacco etc.

Annually, about 13 million deaths are attributable to alcohol related causes, obesity or high Body Mass Index, motor vehicle injuries or associated causes. This begs the need for broader recognition of the impact of corporate activity on people's health. The term 'commercial determinants of health' (CDoH) is increasingly being used to draw attention to the "strategies and approaches used by the private sector to promote products and choices that are detrimental to health". This single concept includes consumer and health behavior, individual choice at the micro level, global risks to society, the global consumer society and the political economy of globalization at the macro level.

Attention and resources are often misdirected to social policies as solutions to public health problems while their the underlying CDoH are ignored or obscured. Therefore, it is imperative that we inform the people about CDoH and engage in conversations with policy makers to better inform closer regulation of harmful commodities and corporate practices around the globe.

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ABSTRACT

As a Matter of Policy: Advancing the Economic Case for Eliminating Men's Health Disparities

In recent years, the public health sphere has evolved to more meaningfully consider what is now framed as the "social determinants of health" (SDOH). According to the World Health Organization (WHO) and the United States Department of Health and Human Services (DHHS), social determinants of health are factors (i.e. socioeconomic status, built environment, housing, education, transportation, social support networks, race/ethnicity, gender, health care services access etc.) that determine the extent to which individuals are able to live the best quality of life possible.

Emerging scholarship has further centered the economic burden of disease across several health indicators (i.e. cancer, heart disease, diabetes, obesity, mental health and other conditions). The lower an individual's socioeconomic position, the higher their risk of poor health. Despite robust health disparities research already in place, there is a paucity of studies that have meaningfully examined the economic impact of health disparities specifically with respect to Black men's health in the United States.

This presentation has four aims: 1) further explore and examine the economic costs of men's health disparities 2) expound on the impact of racism on the cardiovascular health of Black men 3) make an economic case for advancing equity with respect to men's health disparities and 4) provide practical equity-oriented policy-level solutions and strategies to support an advocacy agenda targeting the reduction and/or elimination of men's health disparities.

Health Sciences

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Jillian Catalanotti

ABSTRACT

As Fast as a Drill: Intraosseous Access

Intraosseous (IO) lines are central access catheters inserted utilized through access to the bone marrow. They are an effective method for gaining central access both quickly and reliably. In a coding or unstable patient these can be life saving. This method of central access is recommended by the American Heart association & European resuscitation council.

Unfortunately, some physicians may be either uncomfortable or unfamiliar with this procedure. We have conducted a survey to assess the baseline knowledge and familiarity of IOs to the general internal medicine class, followed by educational lectures during their intensive care unit rotation. We then followed this intervention with a post survey to assess if there was an increase in knowledge & familiarity of IO insertion and use.

To improve the knowledge and comfort level of George Washington University's Internal Medicine residents for IO placement by 20% over a two month duration.

A pre-test and educational video were provided at the start of the PDSA cycle. Comfort level and exposure to the procedure were assessed. An educational session with another video, model humeral head, and IO needle and needle driver were used at the Washington, DC Veterans Affairs Medical Center in the Intensive Care Unit. A post-educational test with the same questions was administered with additional questions to assess interim use of IO lines.

Formalized education regarding IO placement appears at least mildly effective as the number of residents who were "extremely comfortable" with the procedure increased by 50%. The low sample size and poor post-intervention response rate limited the assessment of IO education, although it appears that more people were extremely comfortable with placing IO lines. Further formal education on IO line placement is warranted as it may help to ensure rapid, reliable access in emergent situations.

Health Sciences

Columbian College of Arts and Sciences

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ABSTRACT

CXCL1 Regulates the Expression of Cytokines, Chemokines, and Growth Factors in Breast Cancer

Research from Dr. Vadgama's team has shown that CXCL1 played a significant role in breast cancer cells migration and invasion. It has been identified as an obesity-associated cytokine by Dr. Vadgama's research team and associated with poor clinical outcomes in African American & Hispanic breast cancer patients. The essential roles of CXCL1 in breast cancer development and progression are still under investigation by the team. The goal of this project is to understand the regulating role of CXCL1 in other Cytokines/Chemokines and Growth Factors in breast cancer.

Experimental design and methods: The cell lines MB231 vector control, MB231 shGROα, MCF7 vector control, and MCF7 GROα were used to evaluate the effects of CXCL1 in regulating panels of cytokines and growth factors expression in breast cancer cell lines. Magnetic Luminex Assay with multiplex cytokines kits were used to detect cytokines and chemokines expression in the cell lines. RT-qPCR was used to confirm expression of CXCL1 in the cell lines.

When CXCL1 is knocked down in MB231, it significantly decreases the expression of cytokines, chemokines, and growth factors such as IL6, IL8, MCP-1, EGF. FGF2, TNFα, TGFβ superfamily, IGF1, insulin, and leptin in the conditioned media. Conversely, when CXCL1 is overexpressed in MCF7 it increases the expression of cytokines, chemokines, and growth factors such as EGF, MDC, IP10, GCSF, VEGF-α, TGFβ superfamily, IGF1, insulin, and leptin in the conditioned media.

It can be concluded from the results that CXCL1 is a mediator of the expression of several cytokines, chemokines, and growth factors. Consequently, the increased expression of CXCL1 induced cytokines, chemokines, and growth factors can drive cancer's proliferative, angiogenic, invasive, and migrative capabilities and additionally exacerbate obesity. Therefore, CXCL1 could be an ideal therapeutic target to diminish the comorbidity of breast cancer and obesity and diminish the mortality rate of breast cancer related deaths in Hispanic and African American women.

Health Sciences

Columbian College of Arts and Sciences

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ABSTRACT

Biological Effect of Dual PI3K/HDAC Inhibitor in Cutaneous T-Cell Lymphoma

T-cell lymphoma, a type of NHL that occurs in T lymphocytes, play an important role in immune responses. TCL is a heterogenous group categorized into several subtypes, including CTCL. Cutaneous T-cell lymphoma (CTCL) presents skin symptoms, which are often mistaken for skin conditions. Current treatment plans can take patients several months and even up to a year to respond. Therefore, new treatment options/targets are needed to decrease response time and improve effectiveness. In this regard, PI3K signaling has been shown to have potential significance as a treatment target for various cancers. PI3K is upstream activator of the AKT activation, which leads to uncontrolled protein synthesis and ultimately cancer growth. PI3K inhibitors are in clinical trial with modest activity, therefore this study sought to determine the effect of PI3K inhibition along with histone deacetylase inhibition using a dual tool compound CUDC-907 in CTCL in-vitro.

This study examined the in-vitro biological effect of the CUDC-907 several CTCL cell lines such as HH, H9, HuT 78, and SeAx. The CTCL cells were grown and maintained in RPMI media supplemented with 10% fetal bovine serum and 1% antibiotic mixture. 70-80% confluent cells were plated in a 96-well plate overnight, then treated with CUDC-907. CTCL cells were treated with various concentrations of the drug (10nM, 100nM, 500nM, and 1 uM) for 72 hours in the humidified 37ºC CO_2 chamber. MTT 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium was added, followed by incubation at 37ºC for 4 hours. After the addition of isopropanol, absorbance readings were taken at a wavelength of 570nm using a spectrophotometer. MTT assay results showed a dose-dependent decrease in the cell proliferation in all four CTCL cell lines tested, suggesting an anti-proliferative role of CUDC-907 inhibitor in CTCL cells. Western Blotting experiments followed by treatment with inhibitor were conducted to confirm that CUDC-907 was targeting PI3K signaling. 100nM and 500nM concentrations were used to treat the cell lines for a 24-hour incubation period and then the cells were lysed to extract proteins. Through Gel electrophoresis the proteins and AKT levels were compared with a control group, which received no drug treatment. Results showed a dose-dependent reduction in AKT, and increase in the histone acetylation (hall mark of HDAC inhibitors) confirming the inhibitors targeting PI3K and HDAC pathway.

In conclusion, combined PI3K and HDAC inhibition through CUDC-907 has anti-lymphoma activity in CTCL. This study provides a scientific rationale for clinical study of CUDC-907 in patients with CTCL.

Health Sciences

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ABSTRACT

Hypothalamic and Thalamic Synaptic Morphology after High Fat Diet

The gravity of obesity stems from a variety of determinants in the body that can impact health, such as feeding behavior. Feeding behavior is shown to be strongly regulated by AgRP (Agouti-releasing peptide) neurons (Krashes et al., 2011; Aponte et al., 2011). Our laboratory has shown that AgRP neuron response to less palatable food is decreased after high-fat diet (HFD) exposure (under review). However, the question of whether a HFD causes long-term changes within the AgRP neurons themselves has yet to be explored. One way to explore these changes is by determining bouton quantity in these AgRP neurons after a HFD. Boutons are located at the terminal ends of axons and are responsible for sending signals downstream to other neurons. The paraventricular hypothalamic nucleus (PVH) and paraventricular thalamus (PVT) areas of the brain were imaged as those regions are downstream of AgRP neurons and are largely linked to feeding behavior (Wang et al., 2015; Betley et al., 2013). Transgenic mice which express a fusion gene consisting of synaptophysin, a protein found at the boutons of axons and is specific to synaptic vesicles, were used. The transgenic mice were put on a HFD for one month before being sacrificed where the brain was extracted, sliced and mounted onto slides that were then imaged using a confocal microscope. When imaged using the confocal, a fluorescent filter was used to identify clusters of dots in each region. Once the image was received it was deconvoluted and put under the ImageJ program that automatically counted the amount of boutons in each image. We hypothesize that in the PVH and PVT, the number of boutons in mice fed HFD for one month is less when compared to mice fed a normal chow diet. These results could potentially reveal whether a fatty diet affects how neurons transmit information surrounding feeding, which can be a reason why obesity is such a large epidemic and once diagnosed is so difficult to treat.

Health Sciences

Columbian College of Arts and Sciences

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ABSTRACT

Androgen Responsive Clusterin Expression in the Developing and Regenerating Mouse Prostate

Androgen-deprivation is an effective first line of treatment for prostate cancer, yet new approaches for treatment are needed, as many prostate cancers will ultimately develop resistance. Because much of prostate organogenesis occurs when androgen levels are low, we hypothesized that both androgen receptor (AR)-dependent and AR-independent progenitor cells may exist in the developing prostate. To understand the heterogeneity of prostate epithelial cells at a molecular level, we analyzed single cell RNA sequencing (scRNA-seq) data from developing mouse prostates at postnatal day 0, week(s) -1, -4,-6, and adult prostates at 10 weeks. At each of these timepoints, we identified a population of luminal epithelial cells that expressed Clusterin, which encodes a chaperone protein that has previously been implicated in prostate cancer and is reported to have anti-apoptotic effects.

Since Clusterin is expressed in cells responsible for intestinal epithelial regeneration following injury, we assessed whether Clusterin may also have similar functions during androgen-mediated regeneration in the mouse prostate. Mice were castrated to induce prostate regression and then implanted with testosterone pumps. We assessed Clusterin expression during prostate regeneration by conducting immunofluorescence (IF) staining. We also assessed AR expression in Clusterin-expressing cells by conducting co-staining using antibodies for Clusterin and AR. In developing prostates from 4-week-old mice and in regenerating prostates, we detected Clusterin expression in a small number of luminal cells, many of which expressed high levels of AR, and were enriched at the tips of prostate tufts. The number of Clusterin-expressing cells increased as regeneration progressed, suggesting a response to hormones in these cells.

Our findings suggest that Clusterin is a marker for AR-responsive progenitor cells in the normal prostate, and are consistent with previous research that has shown that AR is a transcriptional activator of Clusterin. These findings warrant further studies on the inhibition of Clusterin as a treatment for castration-resistant prostate cancers that continue to be dependent on AR signaling.

Health Sciences

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ABSTRACT

Utilization of Dual-Labeled Optical Mapping with Bionano Genome Imaging for FSHD Diagnosis

Short-read exome/genome sequencing (SRS) and chromosomal microarrays (CMA) have helped increase diagnostic rates across many genetic disorders. However, despite this success, disorders such as facioscapulohumeral muscular dystrophy (FSHD) are still challenging to diagnose due to the methodological limitations of SRS and CMA. Both fail to provide the underlying structural context and epigenetic profiles in the repetitive region of the human genome. For example, short-read sequencing or methylation arrays do not provide long-range haplotype specific methylation states, rather the detected signals are averaged for individual genomic positions.

These limitations are alleviated with a novel dual-label optical genome mapping (DL-OGM) technology for detection of both genetic and epigenetic changes in one assay over long stretches of single DNA molecules and phased haplotypes. The method relies on differential labeling of high molecular weight DNA. First, long DNA molecules are nicked with BspQI endonuclease and labeled with red fluorescent nucleotides. Second, the same DNA molecules undergo treatment with M.TaqI methyltransferase that attaches green fluorescent cofactor onto non-methylated CpGs in ATCG sequences throughout the genome. Third, the pattern of fluorescent labels is captured in nanochannel arrays for de novo genome assembly, variant calling and quantification of epigenetic marks.

Here, we show the ability of DL-OGM to detect large copy number variants and methylation levels for FSHD diagnosis. We successfully identified the molecular diagnosis (constriction of D4Z4 array and associated hypomethylation) in FSHD case/control samples in the sub-telomeric region of chromosome 4q35. DL-OGM technology offers substantial advantages over the current clinical diagnostic practice of FSHD diagnosis that relies on Southern Blotting as it provides both the genetic and epigenetic level information in a single assay that can be used in clinic for diagnosis and in research to investigate the age of onset, severity and prognosis.

Health Sciences

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ABSTRACT

Exploring the Effectiveness of Family Art Therapy on the Improvement of Familial Relations/Communications: Case Study

There are various stressors of military life such as moves, deployments, and family separation that have been associated with poor communication and strained familial relations within military families. The aim of this research is to review the effectiveness of family art therapy and the ability to improve familial relations and communication in a military family.

This qualitative case study examines a singular family art therapy session that complemented treatment with an adolescent. This research design allows for a detailed focus on how the family experienced art therapy in order to arrive at a holistic and clear impression of the participants, treatment, and outcomes. The family included two parents, adolescent client, and younger brother. The session documented clinician observations and client self-report within art therapy treatment-as-usual, which utilized the Kinetic Family Drawing (KFD).

The family reported that seeing how the other family members perceived situations differently than themselves provided insight into how to better communicate moving forward. In a post-session meeting, the parents reported that they noticed a decrease in anxiety and noticeable improvement in family connectedness. Specifically, they noted that the identified client had reduced his tendency to self-isolate and increased effort to spend time with the family, which improved interactions between the brothers.

The family art therapy session succeeded in providing a space where each family member could express their thoughts and feelings visually. Although one family art therapy session did not completely resolve all tensions related to relationships and communication, family feedback demonstrated better understanding between family members, improved empathy for one another, and a desire to continue in family art therapy services.

Health Sciences

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ABSTRACT

Role of Mutated TP53 in Repetitive Element Regulation

Ovarian cancer accounts for about 2.5% of malignancies among women but 5% of female cancer deaths, indicating a serious disease with a low survival rate. High-grade serous carcinoma (HGSC) is the most common subtype of ovarian cancer and has the worst outcomes. Mutation of the TP53 gene is found in about 96% of HGSC tumors. TP53 is an important tumor suppressor gene that codes for the p53 protein, a nuclear transcription factor that promotes cell cycle arrest, DNA repair and genomic stability.

Endogenous retroviruses (ERVs) are a type of repetitive element that are usually hypermethylated and silenced. In her research, Dr. Katherine Chiappinelli found that DNA methyltransferase inhibitors (DNMTis) such as 5-azacytidine (Aza) upregulate ERVs by blocking their methylation and allowing their overexpression, inducing an immune response. Initial RNA-sequencing results from wild type and mutant TP53 ovarian cancer cell lines show ERVs are expressed at higher levels after Aza treatment in TP53 wild type cell lines compared to TP53 mutant cell lines, perhaps indicating a role for TP53 in ERV transcriptional regulation.

Our goal is to investigate the role of p53 in HGSC using the Hey ovarian cancer cell line, which is wild type p53. We used CRISPR/Cas9 editing to introduce an R175H hotspot mutation into the Hey cell line. R175H is the most common TP53 mutation in human ovarian cancer. By creating single cell clone populations, screening for successfully edited clones using enzyme assays, and performing next generation and Sanger sequencing to validate the presence of the R175H mutation, we created the isogenic cell line HH23 that has mutant p53. We will assess p53 functionality by treating with known p53 agonists, including Nutlin-3A, and assessing expression levels of p53 and related genes using qRT-PCR. We will then treat with Aza and assess subsequent ERV expression using qRT-PCR.

In ovarian cancer, wild type p53 transcriptionally upregulates ERVs while mutant p53 seems to further upregulate them, implying a novel role of TP53 in the regulation of ERVs and other repetitive elements. Using qRT-PCR, Dr. Chiappinelli's lab has found that total ERV levels in human serous ovarian cancer tumor samples (all TP53 mutant) were higher than in fallopian tube samples (all TP53 wild type). Therefore, we hypothesize that HH23 will show more ERV upregulation when treated with DNMTis compared to wildtype p53.

Health Sciences

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ABSTRACT

Combining Innate/Adaptive Cell Therapy Strategies for Cancer

Burkitt's lymphoma is an often fatal form of non Hodgkin's lymphoma, a malignancy of B cells, presenting with a poor prognosis. Adoptive cell immunotherapies have shown success against other EBV-associated lymphomas; currently, however, limited options are available for Burkitt's. We hypothesize that combining two immune effectors (NK cells, the main cellular effector of innate immunity, and T cells, the main cellular effector of adaptive immunity) in a single immunotherapy platform will have better efficacy against this malignancy. T cells can target intracellular antigens within tumors through their interactions with MHC, and NK cells can target extracellular antigens on tumors through antibody-dependent cell-mediated cytotoxicity (ADCC).

To test our hypothesis, we used a Burkitt's lymphoma cell line, Raji, as our model tumor. We have identified LMP2 as an intracellular antigen expressed on Raji. LMP2 has been successfully used as a target for T cells in other lymphomas. We have also identified an extracellular target, glypican-2, on Raji cells. This surface protein is seen in other malignancies, including medulloblastoma and neuroblastoma, and is not expressed in most healthy tissue. We therefore generated LMP2-specific T cells that were transduced to express a GPC2-targeting antibody-like construct that we designed. We successfully transduced three donors, and saw an average of 52.41% transduction efficiency using flow cytometry. An enzyme-linked immune absorbent spot (ELISpot) assay confirmed that these cells specifically recognize LMP2. To quantify the total concentration of antibodies being secreted, enzyme-linked immunosorbent assays (ELISA) are being conducted. A Calcein AM assay will also be performed with gene modified LMP2-specific T cell-conditioned supernatant to evaluate cytotoxicity.

Health Sciences

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ABSTRACT

scMAGeCK Links Genotypes with Multiple Phenotypes in Single-Cell CRISPR Screens

Pooled genetic screens based on CRISPR/Cas9 genome engineering system is a widely used method to study the functions of thousands of genes or non-coding elements in one single experiment.

CRISPR screening coupled with scRNA-seq, which will be referred to as "single-cell CRISPR screening", enables detecting the expression changes of whole transcriptome at a single-cell level. One can potentially search for perturbed genomic elements that lead to the differential expression of certain gene of interest. This approach resembles a fluorescence-activated cell sorting (FACS) experiment, where single cells are separated into groups of high (or low) expression of certain marker. Such "virtual FACS" experiment can be performed on unlimited numbers of phenotypes, represented by the expressions of genes (or gene signatures). Therefore, single-cell CRISPR screening greatly eliminate the limitation of traditional screening experiment, where only one phenotype can be tested. However, few efforts were made to evaluate this approach, and no computational methods are available for the "virtual FACS" analysis based on single-cell CRISPR screening data.

Here we present scMAGeCK, a computational framework to systematically identify genes (and non-coding elements) associated with multiple phenotypes in single-cell CRISPR screening data. scMAGeCK consists of two modules: scMAGeCK-Robust Rank Aggregation (RRA), a sensitive and precise algorithm to detect genes whose perturbation links to one single marker expression; and scMAGeCK-LR, a linear- regression based approach that unravels the perturbation effects on thousands of gene expressions, especially from cells undergo multiple perturbations.

We demonstrated the ability of scMAGeCK to perform functional analysis from single- cell CRISPR screens. We applied scMAGeCK on public datasets generated from CROP-seq, a widely used protocol for single-cell CRISPR screening. When compared with tSNE clustering analysis, we found that for all the datasets, only one to two genes are enriched in clusters, while scMAGeCK identified many targets whose expressions are down-regulated upon knockout with statistical significance. In the evaluation and comparison experiment, scMAGeCK demonstrates better specificity and sensitivity than other existing methods in analyzing single-cell CRISPR screens. Applying this approach to phenotypes, we identified oncogenic and tumor-suppressor genes and enhancers, by simply testing their associations with MKI67 (Ki-67), a commonly used proliferation marker. We further tested our scMAGeCK approach on mouse embryonic stem cells (mESC), and identified key genes associated with different pluripotency states. These outcomes indicated that scMAGeCK enabled the reconstruction of a complex genotype- phenotype network.

Health Sciences

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ABSTRACT

X-Chromatin Inactivation in Human Adipose-Derived Mesenchymal Stem Cells using Single Cell RNA Sequencing

Mesenchymal stem cells are multipotent stem cells that have the ability to differentiate into different cell types including adipocytes. Adipose derived mesenchymal stem cells (ADSCs) are considered to be the best source for mesenchymal cell isolation since adipose tissue is easily accessible and can be obtained using less invasive procedures. These cells have promising clinical applications in medicine. During embryonic development, X-inactivation occurs randomly in individual cells. ADSCs just like other cells undergo X-inactivation. X-chromosome inactivation (XCI) is a phenomenon in which one X chromosome in the female is randomly silenced. Some genes however escape this process and some of the escapee genes have been linked to genetic diseases.

The objectives of this study were to identify the different cell types present in adipose-derived mesenchymal stem cells, establish their XCI status, and compare the findings to existing knowledge in relation to disease and medicine, using single cell RNA sequencing (scRNA-seq) data. To perform this research, we used publicly available scRNA-seq data from 26,640 human adipose-derived mesenchymal stem cells from three healthy females. First, we estimated the different cells types. Across the three individuals, we identified adipocytes, erythrocytes, neutrophils, and naïve B-cells. Within each cell type, we then assessed the expressed variant allele fraction (VAFRNA) at all heterozygous Single Nucleotide Variant (SNV) positions on the X-chromosome. We identified cell-type specific genes that escape the chromosome X-inactivation. These include some genes not previously described as escapees in other tissues. Our future plan is to study the relationship between these escapee genes and their association with certain diseases.

Health Sciences

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Gregory Wallace

ABSTRACT

Autistic Traits and the Aging Brain

Our knowledge of middle and older adulthood in autism spectrum disorder (ASD) is nearly non-existent. The few studies of aging in ASD that have been completed to date are plagued by cohort effects due primarily to the ever-changing diagnostic criteria for ASD over the last several decades. This issue presents seemingly insurmountable confounds to studies examining the possible contributions of autistic behavior to cognitive and brain-based outcomes in later adulthood. However, we have shown in three recent studies that the presence of the Broader Autism Phenotype (BAP), elevated subclinical autistic traits occurring in approximately 15-20% of the population, is associated with increased executive function problems and social cognitive difficulties compared to those without the BAP during older adulthood (60-91 years). The current study uses a similar approach to examine, for the first time, brain-based differences in the BAP during middle and older adulthood.

158 community dwelling adults (73% female) ranging in age from 49-81 (mean=64) years completed a neuropsychological battery of questionnaires and cognitive tasks and provided a Magnetization Prepared-RApid Gradient Echo (MP-RAGE) magnetic resonance imaging (MRI) scan. The BAP was assessed using self-ratings from the well-validated and widely used Autism Quotient. FreeSurfer software was used to quantify cortical and subcortical brain volumes. The resulting brain volumes of the highest quartile of AQ scorers ("BAP"; n=43) were compared to those of the other 75% of the sample ("non-BAP"; n=115) using analysis of covariance (ANCOVA) accounting for the effects of age, gender, and total intracranial volume. BAP adults were found to exhibit decreased brain volume compared to the non-BAP group in both the hippocampus and thalamus (ps<.05) as well as temporal and insular cortical regions (ps<.05), after co-varying the influences of age, gender, and total intracranial volume. This study provides the first evidence that the BAP conveys potential risk to brain health through decreased brain volume during middle and older adulthood, when tissue loss is already occurring in similarly aged neurotypical adults. Most prominently, the BAP group exhibited decreased hippocampal, thalamic, temporal, and insular volumes. Similar findings of brain volumetric reductions have been shown in recent studies of middle-age adults with ASD. This convergence across subclinical (BAP) and clinical (ASD) samples lends validity to the investigation of the BAP in adult development to inform aging in ASD.

Health Sciences

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ABSTRACT

Utilization of Radiotherapy and Epigenetic Modulation to Enhance Cellular Response to Immunotherapy in Melanoma

Radiation therapy (RT) is known to induce tumor cell death by DNA damage and generate new tumor antigens, thereby activating both adaptive and innate host immune responses. However, RT also has significant negative effects on the tumor microenvironment (TME), such as radionecrosis and ablative effects on immune cells. Therefore, there is an urgency to develop novel combination therapies to increase the efficacy of RT. We have shown that epigenetic modifiers such as histone deacetylase 6 have immunomodulatory effects in the TME. Inhibiting HDAC6 with highly selective inhibitors is shown to enhance anti-tumor immunity by affecting macrophage (MΦ) polarization. M1 MΦs have an anti-tumor, pro-inflammatory function which present tumor antigens and activate CD8 T effector cells, whereas M2 MΦs have a pro-tumor, anti-inflammatory function. HDAC6 inhibitors (HDAC6i) are shown to reduce M2 MΦs in the TME thereby increasing the M1/M2 ratio and anti-tumor immunity. Here, we demonstrate the effect of RT and HDAC6i on antigen presentation in tumor cells and macrophages. Using qPCR, we show that the expression of genes involved in antigen presentation (TAP1, TAP2, TAPBP, ERAP1) increased with the combination of RT and HDAC6i in murine SM1 melanoma cells. Flow cytometry further confirmed an increase in antigen presentation with combination therapy using SM1 cells stably expressing chicken ovalbumin antigen. Experiments using bone-derived murine M1 MΦs revealed similar results, with an increase in expression of genes involved in the antigen presentation machinery. Furthermore, flow cytometry confirmed that combination therapy increased antigen presentation by MΦ. Taken together, these data demonstrate that RT in combination with HDAC6i can improve the immunogenicity of melanoma tumors and warrants future experiments involving isolation of CD8+ T-cells from OT-1 mice to test for effects of combination therapy on antigen presentation of SIINFEKL. Clinically, these findings have the potential to advance and shift the current treatment regimen for melanoma.

Health Sciences

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ABSTRACT

Development of Vestibular Ganglion Cells in Congenital Vestibular Disorders

Abnormal development of the vestibular inner ear is found in some congenital disorders (e.g., CHARGE syndrome). In congenital vestibular disorders (CVDs), the most common pathologies are the formation of a sac-like inner ear missing all 3 semicircular canals and absence of vestibular reflex activity. Mutant mouse models of CVDs are confounded by forming multiple inner ear phenotypes, making it difficult to repeat experiments. Therefore, this lab implemented a new animal model to study CVDs. In the two-day old chick embryo (E2), the developing inner ear or otocyst is rotated surgically, forming an anteroposterior-rotated otocyst, which produces a sac-like inner ear with all three semicircular canals missing or truncated, called the ARO/s chick. Besides forming a sac in 85% of cases, ARO/s hatchlings experience impaired vestibular reflexes. At E13 (chicks hatch at E21), all vestibular sensory organs are present in the sacs, but the superior crista and utricular macula are shortened, while brainstem vestibular nuclei neurons are reduced to 34% of the normal neuron number.

Here we investigated whether vestibular ganglion (VG) neurons, involved in transmitting signals from vestibular hair cells to vestibular nuclei neurons, are also reduced in number in ARO/s chicks, as reported for children with CVDs. Counts of VG were made on images taken on a Leica inverted microscope from Nissl-stained, 20 µm, transverse serial sections of ARO/s chicks. VG neurons were counted on every third section from a complete series of VG sections and then multiplied by 3 to obtain total ganglion cell counts on the images using QuPath computer program. VG volume was determined by outlining the ganglion on every third section to obtain section area, multiplied by 60 to account for ganglion depth, and finally the serial sections were added together. In ARO/s chicks (n=2), VGs on the rotated side contained 3,635 ± 197 (SEM) neurons, which represent 62% of neurons on the intact side (5,820 ± 18 neurons). VG volume in ARO/s chicks on the rotated side was reduced to 61% of the volume on the intact side. This study supports reduced VG neuron number on the rotated side of ARO/s chicks, as found in children with CVDs. Since nothing is known about changes in the central vestibular system in CVDs, the ARO/s chick offers an animal model to study how the sac-like inner ear pathology affects development of the central vestibular neural circuitry.

Health Sciences

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ABSTRACT

Validating a Self-Esteem IAT for Assessing Cognitive Distortions

This study looks to validate an Implicit Association Test (IAT) of self-esteem to assess cognitive distortions. Many studies use explicit measures to assess cognitive distortions when studying depression symptoms. The Cognitive Distortions Questionnaire (CD-Quest) is a validated explicit measure that is commonly used in studies of depression and cognitive behavioral therapies. The CD-Quest is also commonly used as a self-report measure because it is cost effective and relatively easy to distribute. Recently some studies of depression have incorporated using the self-esteem IAT because negative self-assessment is connected to depressive symptoms. However, the Implicit Association Test (IAT) for self-esteem has not been validated to assess cognitive distortions. In this study, we will analyze data that was collected from another study on the impact of mindfulness practice of cognitive distortions. Participants were GW students who completed the CD-Quest and self-esteem IAT online pre- and post-intervention, and the scores for the self-esteem IAT will be compared to the CD-Quest to ensure construct validity. This study is important for future research in clinical and social psychology and hopes to promote the use of the self-esteem IAT in studies of cognitive distortions and depression.

Health Sciences

Columbian College of Arts and Sciences

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ABSTRACT

Persistent Chikungunya Arthritis in Roraima, Brazil

The Amazon region of Brazil experienced a large epidemic of East Central South African (ECSA) chikungunya virus (CHIKV) in 2017 and continuous transmission of CHIKV persists. The impact of chronic arthritis caused by ECSA CHIKV is unknown.

The study aim was to describe the duration, severity, and characteristics of CHIKV arthritis in Roraima, Brazil in comparison to local controls to further understand the long-term rheumatologic impact of ECSA CHIKV infection.

We performed a cross-sectional analysis comparing clinical arthritis outcomes among 40 cases with chronic (>3 months) arthritis attributed to their CHIKV disease (n=40) to control participants who were exposed to CHIKV but did not develop chronic arthritis (n=40), rheumatoid arthritis controls (n=40) and healthy controls lacking CHIKV exposure and arthritis (n=40).

Our primary finding is that over two years post-infection, patients report moderate arthritis disease severity comparable with rheumatoid arthritis with the most significant impact on decreased quality of life from pain.

These findings suggest that chronic arthritis caused by ECSA CHIKV infection has had a moderate impact in the Americas.

Key points:

1) Chikungunya infection is responsible for moderate arthritis disease severity.
2) The East Central South African (ECSA) strain of CHIKV is a cause of persistent arthritis in Roraima, Brazil.

Health Sciences

Columbian College of Arts and Sciences

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ABSTRACT

Potential Impact of the Red Blood Cell Storage Lesion on Cardiac Electrophysiology

Studies suggest that transfusion complications may be partly attributed to red blood cell (RBC) storage lesion, a series of morphological, functional, and metabolic changes that RBCs undergo during refrigerated storage. RBC storage lesion is further exacerbated by irradiation, which can result in supernatant potassium concentrations that far exceed normal plasma levels. As such, RBC storage lesion severity may contribute to transfusion-associated cardiac complications, including hypocalcemia, hyperkalemia, low cardiac output, and cardiac arrest. Studies are needed to resolve the direct relationship between RBC storage conditions and adverse cardiac effects. Packed RBCs were obtained from the American Red Cross and aliquoted into small volume blood bags for refrigerated storage (7 – 40 days, post donor collection). The supernatant of packed RBCs was collected, and transfusion-exposure was simulated by supplemented 10-17% of 1) cell culture media for human induced pluripotent stem cell-derived cardiomyocytes (hiPSC-CM) or 2) perfusate for isolated rat whole heart preparations. Isolated whole hearts were perfused using a langendorff system with Krebs Henseleit buffer, and supernatant was added in acute dosing protocols. Cardiac electrophysiology was quantified at baseline and after RBC supernatant exposure. hiPSC-CM spontaneous beating rate remained stable under control media conditions (1.3±0.24s cycle length) compared with supplementation with 7-day old RBC supernatant but slowed immediately after application of supernatant from older blood products (18-day: 2.0±0.65s and 35-day: 1.8±0.44s, $p<0.01$). In isolate whole hearts, the ventricular effective refractory period was significantly increased for day 40 blood bags ($p< 0.01$). Furthermore, atrial ventricular node end refractory period, Wenkebach cycle length, and sinus node recovery time was also significantly increased when comparing baseline to day 40 supernatant ($p<0.01$, $p<0.001$ and $p<0.05$ respectively). Many studies agree that the RBC storage lesion occurs as RBC units are stored over time. However, there is disagreement on the clinical impact of the storage lesion and whether older blood units present an increased risk to patients. Using an in vitro cardiac model, we show that RBC storage time significantly impacts both the spontaneously beating rate and depolarization spike amplitude. Whole heart cardiac electrophysiology studies show that RBC storage lesions have a significant effect on the effective refractory period, atrial node, and sinus node function.

Health Sciences

Columbian College of Arts and Sciences

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Leon Grayfer

ABSTRACT

Assessing the Gastrointestinal Immune Responses of the Amphibian Xenopus Laevis to the Frog Virus 3 Ranavirus

Ranaviruses such as Frog Virus 3 (FV3) are significantly contributing to the global amphibian declines. In turn, while antiviral type I and III interferon (IFN) cytokines represent the cornerstone of vertebrate antiviral immunity, our past work indicates that the relatively more FV3-susceptible tadpoles of the Xenopus laevis frog mount disparate IFN responses than the more-resistant adult counterparts. Notably, as FV3 infects its amphibian hosts across mucosal surfaces such as their gastrointestinal (GI) tissues, gaining greater insights into how tadpoles and adult frogs differ in their responses to these pathogens at these sites is of utmost importance. Accordingly, we investigated the tadpole and adult X. laevis GI responses to FV3 following animal water-bath exposure to this pathogen. We observed substantial differences in tadpole and adult frog immune responses to GI infections, marked not only by differences in IFN gene expression but also by differences in key innate immune cell markers. Together, our results suggested that tadpoles, but not adult frogs, recruited innate immune cells into their GI tissues shortly after FV3-challenge. To identify the lineage(s) of the GI-infiltrating cells, we performed specific and non-specific esterase stains of FV3-infected tadpoles GI tissues. These studies indicated that tadpoles were recruiting innate immune cells with specific esterase activity into their infected GIs. Our follow-up microscopy analysis of these cells revealed that they possessed either mononuclear or polymorphonuclear morphology, suggesting that these cells were likely of macrophage as well as of granulocyte lineages. Future studies of these immune subsets will help delineate the differences between tadpole and adult frog immune responses to FV3 and thus define possible facets of the respective susceptibility and resistance to this pathogen.

Health Sciences

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Rong Li

ABSTRACT

Adipocyte PD-L1 Suppresses Anti-Tumor Immune Response and Promotes Breast Cancer Progression

PD-L1 has become a major target in anti-cancer immunotherapy, however the overall response rate still remains relatively low among most types of cancers, notably breast cancer. There is an unmet need to boost efficacy of immune checkpoint blockade therapies. While both tumor and host immune cell-derived PD-L1 are implicated in immune suppressive functions of PD-L1, the exact immunosuppressive contribution of PD-L1 from different host tissues is little studied. Here we show that PD-L1 expression is significantly higher in human breast adipose tissue versus stromal vascular fractions. In vitro adipogenesis of mouse pre-adipocytes significantly up-regulates PD-L1 versus pre-adipocytes. In vitro co-culture shows that adipocyte PD-L1 suppresses T cell activation and response to anti-PD-L1. In an adipocyte-specific knockout (KO) mouse model, we show that syngeneic mammary tumors grow slower in KO than wildtype hosts. Immunophenotyping shows that tumors grown in KO mice have higher CD8+ and CD4+ T cell infiltration. Tumor tissue RNA-seq analysis reveals that genetic ablation of adipocyte PD-L1 confers a distinct transcriptomic signature of T cell activation and tumor killing. Our current findings uncover a previously unappreciated source of immune suppressive PD-L1 in the breast cancer microenvironment and could inform novel therapeutic strategies through targeting tumor-surrounding adipose tissue for treating breast cancer.

Health Sciences

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Anelia Horvath

ABSTRACT

Variation-Splicing Correlations from 10x Genomics Single-Cell RNA-Sequencing Data

With the recent advances in single-cell RNA-sequencing (scRNA-seq) technologies, estimation of allele expression from single cells is becoming increasingly reliable. Allele expression (AE) is both quantitative and dynamic and is an essential component of the genomic interactome. We explored the possibility to assess AE from scRNA-seq data and to correlate it to other quantitative and dynamic transcriptome features in search for functional genomic interactions. To do that, we estimate and analyse EA at heterozygous single nucleotide variant (SNV) loci from scRNA-seq data generated on 10x Genomics Chromium platform. This analysis was carried out on 26,640 human adipose-derived mesenchymal stem cells (from three healthy donors), with an average sequencing reads approximately 150K/cell (more than 4 billion scRNA-seq reads total). High quality SNV calls assessed in our study contained approximately 15% exonic and >50% intronic loci. To analyse the allele expression, we estimate the expressed Variant Allele Fraction (VAFRNA) from SNV-aware alignments and analyse its variance and distribution (mono- and bi-allelic) supported by different minimum number of sequencing reads (cutoffs). Our analysis shows that when assessing positions covered by a minimum of 3 unique sequencing reads over 50% of the heterozygous SNVs show bi-allelic expression, while at minimum of 10 reads nearly 90% of the SNVs are bi-allelic. We, then, analyse the relationship between VAFRNA and splicing, assessed as proportion of excised introns at loci with differential intron excision. To do that, we carried out splicing Quantitative Trait Loci (sQTL) analysis on this data and compared it with those already annotated and referenced in the Genotype-Tissue Expression (GTEx) portal, which were on bulk RNA-Seq data. The results from our analyses demonstrate the feasibility of scVAFRNA estimation from current scRNA-seq datasets and shows that the 3'-based library generation protocol of 10x Genomics scRNA-seq data can be informative in SNV-based studies, including sQTL.

Health Sciences

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Linda Kusner

ABSTRACT

Interferon Gamma May Regulate the Expression of Survivin in Peripheral Blood Mononuclear Cell of MG Patients

Myasthenia Gravis (MG), an autoimmune disease, requires specific T cell activation which supports the development of autoreactive B cells. The majority of patients with MG have antibodies directed at the acetylcholine receptor (AChR) which results in complement mediated lysis of the neuromuscular junction. Interferon gamma (IFN-ɣ) is a cytokine released by T cells that has shown to exacerbate the symptoms of myasthenia by stimulating the autoreactive B cells. Previous studies found the anti-apoptosis protein, survivin to be a potential therapeutic target for MG by limiting B cell proliferation. This study assesses the influence of IFN-ɣ stimulation on survivin expression in MG patients and healthy controls peripheral blood mononuclear cells (PBMCs).

We collected blood from MG patients and healthy controls from the MG clinical at GWU with approval by the George Washington University Institutional Review Board. PBMCs were isolated by Ficoll gradient and stored at -80°C in FBS plus DMSO. PBMCs from healthy and MG patients were cultured with or without IFN-ɣ for 72 hours followed by RNA extraction with mirVana RNA extraction kit. Real-time analysis was performed to determine the effect of IFN-ɣ.

The mRNA expression of survivin did not vary between MG and healthy controls. As well, the addition of IFN-ɣ did not alter the levels of survivin.

The results suggest that isolation of CD20 B cells from the PBMCs may demonstrate the changes in survivin expression. Further analysis of IFN-ɣ and survivin expression by cell sorting will aid in the understanding of the influence of survivin in MG.

Health Sciences

Columbian College of Arts and Sciences

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Colin Young

ABSTRACT

Lack of Endoplasmic Reticulum Stress in the Forebrain Subfornical Organ Following High Fat Diet Feeding in Female Mice

Non-alcoholic fatty liver disease (NAFLD), characterized by hepatic steatosis, is directly associated with obesity and is a significant contributor to chronic metabolic and cardiovascular diseases. The incidence of NAFLD is significantly higher in males than premenopausal females, yet the mechanisms that protect females from fatty liver remain unclear. Endoplasmic reticulum stress and activation of the unfolded protein response (UPR) has emerged as a key mechanism in the pathogenesis of NAFLD in males. In particular, we have previously shown that high fat diet feeding in male mice elicits activation of the UPR in the forebrain subfornical organ (SFO), a circumventricular nucleus that lacks a blood-brain-barrier. Furthermore, alleviation of endoplasmic reticulum stress selectively in the SFO of obese male mice was effective in rescuing NAFLD. Based on this, we hypothesized that endoplasmic reticulum stress would not occur in the SFO of female mice on a high fat diet. C57BL/6J female mice were placed on high fat diet (60% kCal fat) or remained on normal chow for a period of 10 weeks. Histological analysis of the liver using Oil Red O staining of neutral lipids indicated a modest ~3.5 fold increase in hepatic steatosis following high fat diet feeding in female mice (1.0±0.3 vs. 3.5±0.4, normal chow vs. high fat diet, fold normal chow, p<0.05, n=5/group). In line with the sexual dimorphism in NAFLD, in male counterparts, diet-induced obesity was associated with a robust ~60 fold increase in liver lipids (1.0±0.2 vs. 58.2±16.9, normal chow vs. high fat diet, fold normal chow, p<0.05, n=3-4). Gene expression from micropunches of the SFO for the endoplasmic reticulum chaperone glucose regulated protein 78 kDa (GRP78), which is upregulated during periods of endoplasmic reticulum stress, indicated no difference between female mice on high fat diet and normal chow (1.2±0.5 vs. 1.0±0.4 fold normal chow, normal chow vs. high fat diet, p>0.05, n=4/group). Similarly, the UPR markers, C/EBP homologous protein (CHOP), 94-kDa glucose-regulated protein (GRP94), inositol-requiring enzyme 1α, and spliced x-box binding protein 1 were not different between female groups (e.g. GRP94: 1.1±0.3 vs. 1.2±0.2 fold normal chow, normal chow vs. high fat diet, p>0.05, n=4/group). However, in male mice, clear elevations in UPR markers were found in the SFO following high fat diet feeding (e.g. CHOP: 1.1±0.2 vs. 2.3±0.2; GRP78: 1.0±0.1 vs. 1.5±0.1 fold normal chow, normal chow vs. high fat diet, p>0.05, n=3/group). Taken together, these results indicate a lack of UPR activation in the SFO during high fat diet feeding in female mice. Given the crucial role of SFO endoplasmic reticulum stress in NAFLD, these findings point to a potential mechanism that protects premenopausal females from NAFLD development.

Health Sciences

Columbian College of Arts and Sciences

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Amy Sutton

ABSTRACT

Addiction-Like Behaviors with High-Fat and High-Sugar Diets

Chronic obesity can lead to the development of a myriad of conditions such as type II diabetes, cardiovascular disease, and stroke. The widespread availability and overconsumption of highly palatable foods, such as those high in saturated fats and simple sugars, are thought to be some of the most significant contributors to the epidemic. Diets high in fat and sugar are suggested to entail addiction-like behaviors, yet the behavioral outputs underlying the motivation to seek out these foods are still poorly understood. Mice exposed to only one-day of high-fat food display a robust preference for it over normal chow, and also devalue their normal chow after the high-fat chow is removed. This suggests that a "withdrawal" period ensues after the more favorable high-fat chow is removed. However, an individual's motivation to obtain high-fat and sugar-rich food has not yet been investigated, in part due to the technological limitations of most food intake approaches.

Feeding Experimentation Devices (FEDs) allow for pre-programmed feeding regimens of food pellets. They are equipped with sensors that can detect nose pokes and food consumption from mice. Here, we demonstrate that mice with access to both sucrose and normal chow pellets show a significant preference towards sucrose. During a period of withdrawal from the sucrose diet, no devaluing of normal chow pellets occurred. However, upon re-exposure to sucrose, the mice chose to eat much more than the initial baseline, suggesting that the withdrawal period increases sucrose preference. To measure motivation for sucrose and normal chow, we used fixed ratio feeding schedules, in which the chow FED required only one nose poke for one pellet (FR1), and the HFD FED required 5 nose pokes for one pellet (FR5). We found that on this feeding regimen, the mice exerted more than 5 times the effort to eat sucrose over normal chow. Secondly, we investigated preference and level of effort exerted for high-fat diet (HFD) pellets over chow pellets. Within one day, mice chose to consume significantly more HFD than chow pellets, and this is more robust than baseline sucrose intake. Preliminary results suggest that within-mouse comparisons can be performed across diets to determine an individual's susceptibility to engage in food addiction-like tendencies. Prospective implications for this research suggest obtaining a better understanding of the neural mechanisms underlying food addiction. Specifically, we intend to understand the neural networks engaged during these tasks.

Health Sciences

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ABSTRACT

Evaluation of the Modulatory Role of HDAC6 on the JAK-STAT3 Pathway

The JAK-STAT3 pathway controls the expression of several genes, and its inappropriate activation has been associated with several diseases, including cancer. The Signal Transducer and Activator of Transduction 3 (STAT3) needs to be Acetylated (Lys 685) and Phosphorylated (Tyr 705) to form stable dimers and translocate to the nucleus. On the nucleus, STAT3 binds the promoter regions of genes and enhances their transcription. STAT3 directly interacts with the protein Histone Deacetylase 6 (HDAC6), one of the cytosolic zinc-dependant histone deacetylases. It has been shown in previous studies that the STAT3 -HDAC6 interaction favors the conservation of the phosphate group on Tyr 705 from the STAT3, protecting it from phosphatases proteins such as the Protein Phosphatase 2A (PP2A), indirectly favoring STAT3 dimerization and translocation to the nucleus. This interaction favors STAT3 activity, being comparable with the activity of the engineered constitutively active STAT3. This study aims to understand the role of HDAC6 in the STAT3 activity using a bioinformatic approach and molecular dynamics simulations. We established a pipeline for the structural analysis of STAT3 (PDB ID: 3CWG, 6QHD, 1BG1), HDAC6 (PDB ID: 5EDU), and PP2A (PDB ID: 2NPP), and their interactions. In the case of STAT3, we used Homology Modelling to obtain a complete tertiary structure. The first group of interactions was done using Z-DOCK for the Protein-Protein docking and Amber 2018 for a 200 ns molecular dynamics simulation with a temperature of 309.65 K with protein structures without post-translational modifications. The results showed that the complex between STAT3 and HDAC6 has increased stability when there is an approach of the catalytic pocket of HDAC6 for Lysine 685. In the case of the interaction between STAT3 and PP2A, the most stable interaction is shown when the residue Tyr 705 of STAT3 is close to the catalytic pocket of PP2A. The electrostatic surface of the interacting complexes showed that the charge distribution merged between HDAC6 and STAT3 when the catalytic pocket of HDAC6 is oriented to the Lys685 residue of STAT3, and in the case of the complex between STAT3 and PP2A, the electrostatic surface of both proteins are stable when the residue Tyr 705 of STAT3 is oriented to the catalytic pocket of PP2A. The results of the molecular modeling and docking suggest that HDAC6 would be an enhancer of STAT3 activity. Therefore, the disruption of this interaction could be an important target for the development of new therapies against cancer.

Health Sciences

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Isabel De Araujo Salgado

ABSTRACT

Mapping Neuronal C-Fos Activation to Determine the Role of Fear in Feeding Behavior

Mammals have to constantly make decisions based on a mix of internal and external cues, and the question remains why one factor would have more influence over another. For instance, a starved animal will actively forage for food. However, in the presence of a predator, the animal's prioritization changes and it is more reluctant to venture for food. It is unknown why the mouse will prioritize safety over need to eat when homeostatic levels are so depleted. The goal in the following project is to unveil the underlying neuronal circuits mediating the balance between metabolic need and threat avoidance.

We established a paradigm to study the feeding behavior of starved animals in a safe versus harmful environment. Using this paradigm we mapped the topography of brain activity by measuring c-Fos protein expression, a well-known marker of neuronal activity. Neuronal regions relating to hunger and/or stress were closely examined. We found an increase of cFos expression within the arcuate nucleus (arc) of a food-deprived animal when placed in a safe environment. This finding is consistent with previous investigations describing specialized neurons expressing agouti-related peptide (AgRP) located in this region, which are activated by energy deficiency and drive feeding behavior. However, when a fasted animal was placed in the presence of a predator, there was less activity measured within the arc. This indicates that a relationship may exist between the AgRP neurons and one or multiple fear responsive neuronal regions, causing this alteration in response. The next goal will be to determine what underlying circuits cause this inhibition of AgRP neurons in a fear stimulating environment.

Health Sciences

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ABSTRACT

Adapting Color-Coded Glasgow Coma Scale Severity Labels to Protect TBI Survivors

Traumatic brain injury (TBI) survivors who sue to recover medical and non-medical expenses must present medical evidence of injury. Medical professionals use the Glasgow Coma Scale (GCS) score with its corresponding severity labels (mild, moderate and severe) as a consciousness assessment tool for TBIs. In litigation, GCS scores and severity labels become part of the objective medical evidentiary record, which influences judicial and jury perception of the injury, in turn affecting patients' financial recovery. This descriptive study analyzes the proliferation of GCS in patients' legal recovery. The purpose of this study is to understand how GCS scores are utilized by lawyers to assess TBI severity, which affects survivor's financial compensation. The objective is to describe the disconnect between medicine's use of GCS as an assessment tool and the law's use of GCS severity classifications as de facto diagnoses. We utilized the main legal research database LexisNexis, which consists of public legal documents, to assess use of GCS scores in American civil litigation. First, scope was assessed using search terms "brain injury," "head injury" or "concussion." To further assess the direct effect of the objective use of GCS in litigation we then searched "Glasgow Coma." Case results were sorted for civil proceedings, followed by analysis of specific GCS use per case.

Initial search criteria resulted in the number of cases citing these injuries with the potential to use GCS severity labels as evidence. Added criteria resulted in official court opinions with expressed GCS use. In these cases, GCS scores with severity labels (mild, moderate or severe) were used to assess, discredit, or demonstrate a patient's proof of TBI severity. American civil litigation uses patient GCS scores and corresponding severity labels as medical documentation for determining compensation. Cases that met our criteria used GCS severity labels as de facto diagnoses, even though the medical community internally uses GCS severity labels to shorthand patient status and prognostication, not diagnose. By using the adjectival severity labels (mild, moderate, or severe) the medical community is unintentionally providing the legal system with "diagnoses" of TBI severity, which influences patient compensation. A solution we propose is the use of an adapted scale, GCS-Kelly (GCS-K), that replaces the severity adjectives to color labels. GCS-K will not change the intended medical utility of the scale, but will neutralize the connotations, allowing patients to fairly seek recovery without being harmed by unnecessary adjectival classifications.

Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Laura Tosi

ABSTRACT

Genetic Variation in COLIA1 rs1800012 Influences Skeletal Phenotypes in Young Adults

A low-frequency G to T polymorphism within COL1A1 rs1800012 has shown to be a determinant of osteoporotic fractures, low bone mineral density, and intervertebral disc degeneration and in postmenopausal women2,4. A study by Cousminer et al. (2019) elaborated on this work and found that variation in rs1800012 influences bone accrual in children and adolescents2.

This study aimed to expand these findings and further explore how variation in rs1800012 influences musculoskeletal phenotypic in two cohorts of healthy young adults.

The Assessing Inherited Markers of Metabolic Syndrome in the Young (AIMMY) was comprised of healthy Caucasian young adults recruited as part of a study to identify genetic variants associated with risk factors for metabolic syndrome. Functional Single Nucleotide Polymorphism Associated with Human Muscle Size and Strength (FAMuSS) was comprised of healthy young adults who participated in a strengthening program of their non-dominant arm. Genotyping: This study used the Applied Biosystems QuantStudio 7 Flex Real-Time PCR System and Applied Biosystems Taqman Allelic Discrimination. Statistical Analysis: Analysis of covariance (ANCOVA), using additive genetic models, were used to test relationships among SNP genotypes and phenotypes for bone quality.

In FAMuSS, variation in rs1800012 was associated with baseline bone volume in the non-dominant arm (p=0.022), baseline cortical bone volume in the both arms (p=0.036, p=0.037) in females.

This study found a significant association between COL1A1 rs1800012 and baseline humeral bone volume in the non-dominant arm, and baseline humeral cortical bone volume in the dominant arm. Contrary to the previous, our work did not find a significant association between total BMD and variation in rs1800012. As noted in previous literature, this is a sex-specific finding and was not found in males. This study expands our understanding of how variation in COL1A1 rs1800012 impacts bone quality phenotypes in females.

Health Sciences

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Marie Borum

ABSTRACT

Clinical Outcomes and Predictors of Mortality in HPS (Hepatopulmonary Syndrome)

Hepatopulmonary syndrome (HPS) is defined as the presence of the triad of an arterial oxygenation defect, intrapulmonary vasodilation, and the presence of liver disease, usually liver cirrhosis. HPS is an entity that is incompletely understood, with growing data on its impact on mortality. In this study, we sought to determine the clinical outcomes and predictors of mortality among patients with HPS.

Patients with HPS were identified using the National Inpatient Sample (NIS) data from 2012 to 2016, using the International Classification of Diseases, 9th and 10th revision, Clinical Modification (ICD-CM) codes, K76.81 and 573.5. The patients were divided into two groups based on their mortality outcomes to compare baseline demographic and health characteristics. A logistic regression model was then used to determine the predictors of inpatient mortality.

A total of 2128 patients with HPS were identified, 51% were male. Of these patients with HPS, 248 patients died. The mean age of the patients with HPS who died was higher when compared to patients with HPS who did not die (54 ± 15 vs.57 ± 13, p-value <0.001). Overall, we found a modest increase in the number of HPS cases over our study years (326 cases in 2012 vs. 464 in 2016), with no significant change in mortality (12% vs. 12%). Advanced age in patients with HPS was associated with higher odds of death after adjusting for smoking, COPD, CKD, peripheral artery disease, atrial fibrillation/flutter, and pulmonary arterial hypertension.

In this large nationally represented US population sample of HPS patients, we found a mortality rate of 12%, with statistically significant higher odds of death in HPS patients with advanced age.

Health Sciences

School of Medicine and Health Sciences

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Gaetano Lotrecchiano

ABSTRACT

Using a Complexity Lens to Illuminate the Physician-Researcher in the Drug Regulation Pathway

As the amount of FDA-regulated, industry-sponsored clinical researcher continues to grow, it is expected that the role of the physician as a researcher will evolve and relevant standards to guide the physician-researcher's work will be adopted. However, a scan of the regulatory landscape does not support a relationship between the development of the physician researcher profession and US supported regulations. This study describes (1) how the timeline of the development of the physician-researcher profession aligns with the development of regulations and standards for medical product development in the US; and (2) how complexity thinking informs the approach used by stakeholders to guide physician-researchers in the industry development of medical products.

Three perspectives were created for a timeline: milestones in the Food and Drug Administration (FDA), critical public health incidents and tragedies precipitating regulations and standards for drug development and clinical investigation, and the creation of science education and advocacy initiatives for physicians. The Cynefin Leaders Framework for Decision-making was applied to each incident reported on the timeline. Inference was made about the reaction the resulting regulatory response was associated with: sense-categorize-respond, sense-analyze-respond, probe-sense-respond, or act-sense-respond.

Through five decades of health tragedies medical product regulations were enacted as regulatory responses with a focus on industry oversight of clinical research and the need for patient protection. In parallel, growth is seen in advocacy and professional societies and initiatives aimed at increasing the number of physicians actively engaging in medical research. Historically, most regulations were enacted as a regulatory response to a public health tragedy, suggesting an action of leaders to act, sense, and respond in the chaotic contexts. In contrast, current initiatives to develop and implement best practices in the profession suggests a simple, straightforward approach (sense-categorize-respond) to managing the work of physician-researchers.

Overall, regulations and standards have focused on the legal obligations of the manufacturer, the oversight obligations of the institutional review board, and the obligations for everyone on the research team to protect the research participant. Although the physician participation in clinical investigations has been advocated for over 100 years, the physician-researcher profession is largely unregulated. Future research into the complexity of the physician-researcher profession may provide insight into whether the process-oriented solutions provided by regulators and policy leaders is suitable for the context where physician-researchers work.

Health Sciences

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ABSTRACT

Clinical Outcomes and Predictors of Mortality in HPS (Hepatopulmonary Syndrome)

Hepatopulmonary syndrome (HPS) is defined as the presence of the triad of an arterial oxygenation defect, intrapulmonary vasodilation, and the presence of liver disease, usually liver cirrhosis. HPS is an entity that is incompletely understood, with growing data on its impact on mortality. In this study, we sought to determine the clinical outcomes and predictors of mortality among patients with HPS.

Patients with HPS were identified using the National Inpatient Sample (NIS) data from 2012 to 2016, using the International Classification of Diseases, 9th and 10th revision, Clinical Modification (ICD-CM) codes, K76.81 and 573.5. The patients were divided into two groups based on their mortality outcomes to compare baseline demographic and health characteristics. A logistic regression model was then used to determine the predictors of inpatient mortality.

A total of 2128 patients with HPS were identified, 51% were male. Of these patients with HPS, 248 patients died. The mean age of the patients with HPS who died was higher when compared to patients with HPS who did not die (54±15 vs.57±13, p-value <0.001). Overall, we found a modest increase in the number of HPS cases over our study years (326 cases in 2012 vs. 464 in 2016), with no significant change in mortality (12% vs. 12%). Advanced age in patients with HPS was associated with higher odds of death after adjusting for smoking, COPD, CKD, peripheral artery disease, atrial fibrillation/flutter, and pulmonary arterial hypertension.

In this large nationally represented US population sample of HPS patients, we found a mortality rate of 12%, with statistically significant higher odds of death in HPS patients with advanced age.

Health Sciences

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ABSTRACT

Using a Complexity Lens to Illuminate the Physician-Researcher in the Drug Regulation Pathway

As the amount of FDA-regulated, industry-sponsored clinical researcher continues to grow, it is expected that the role of the physician as a researcher will evolve and relevant standards to guide the physician-researcher's work will be adopted. However, a scan of the regulatory landscape does not support a relationship between the development of the physician researcher profession and US supported regulations. This study describes (1) how the timeline of the development of the physician-researcher profession aligns with the development of regulations and standards for medical product development in the US; and (2) how complexity thinking informs the approach used by stakeholders to guide physician-researchers in the industry development of medical products.

Three perspectives were created for a timeline: milestones in the Food and Drug Administration (FDA), critical public health incidents and tragedies precipitating regulations and standards for drug development and clinical investigation, and the creation of science education and advocacy initiatives for physicians. The Cynefin Leaders Framework for Decision-making was applied to each incident reported on the timeline. Inference was made about the reaction the resulting regulatory response was associated with: sense-categorize-respond, sense-analyze-respond, probe-sense-respond, or act-sense-respond.

Through five decades of health tragedies medical product regulations were enacted as regulatory responses with a focus on industry oversight of clinical research and the need for patient protection. In parallel, growth is seen in advocacy and professional societies and initiatives aimed at increasing the number of physicians actively engaging in medical research. Historically, most regulations were enacted as a regulatory response to a public health tragedy, suggesting an action of leaders to act, sense, and respond in the chaotic contexts. In contrast, current initiatives to develop and implement best practices in the profession suggests a simple, straightforward approach (sense-categorize-respond) to managing the work of physician-researchers.

Overall, regulations and standards have focused on the legal obligations of the manufacturer, the oversight obligations of the institutional review board, and the obligations for everyone on the research team to protect the research participant. Although the physician participation in clinical investigations has been advocated for over 100 years, the physician-researcher profession is largely unregulated. Future research into the complexity of the physician-researcher profession may provide insight into whether the process-oriented solutions provided by regulators and policy leaders is suitable for the context where physician-researchers work.

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ABSTRACT

Seasonal and Temporal Analyses of Disease Onset and Diagnosis in Myositis Autoantibody Phenotypes in Juvenile Dermatomyositis (JDM)

Published studies suggest seasonal occurrence of disease onset and disease activity in patients with adult idiopathic inflammatory myopathies (IIM). Our objective was to evaluate seasonal variation of disease onset and diagnosis and the distribution over time of myositis autoantibodies in JDM.

This study includes disease onset and diagnosis data of 383 myositis patients enrolled in NIH studies from 1994 to 2015. Myositis-specific autoantibodies (MSA) tested by standard immunoprecipitation (IP) and IP-immunoblotting methods. Five autoantibody subtypes identified: 35 patients with JDM diagnosed before age 18 years with anti-melanoma-differentiation gene 5 (MDA5) autoantibodies, 157 with anti- transcriptional intermediary factor 1 (TIF1), 116 with anti-nuclear matrix protein 2 (NXP2), 15 with anti-synthetase (ARS) autoantibodies and 60 MSA-negative JDM patients, all meeting probable or definite Bohan and Peter criteria. We studied overall seasonable patterns of disease onset and diagnosis dates (by month) and performed comparisons between autoantibody subtypes. Rayleigh, Watson two sample, and proportion trend tests were used for statistical analysis. Results: There was no seasonal clustering of the month of disease onset in JDM patients as a whole nor in the anti-ARS, anti-MDA5, anti-TIF1, anti-NXP2 autoantibody-positive and MSA-negative JDM subgroups. Anti-ARS autoantibody positive JDM patients had a seasonal pattern of disease diagnosis, with a peak time of diagnosis from May to July, and no patients with anti-ARS autoantibodies were diagnosed from January to April ($p=0.03$). There were no differences in the seasonal patterns of disease onset and disease diagnosis of anti-MDA5 autoantibody-positive JDM patients compared to anti-TIF1 and anti-NXP2 autoantibody-positive, and MSA-negative patients ($p>0.1$). In examining the frequency of MSAs over time, from 1988 to present, we found no significant differences in the trend over time of frequencies of the MSAs or symptom onset or diagnosis in anti-MDA5 autoantibody-positive JDM patients compared to anti-TIF1 and anti-NXP2 autoantibody-positive subgroups ($p>0.2$).

Similar to adult IIM patients, JDM patients with anti-ARS autoantibodies demonstrate a spring to early summer seasonal peak in diagnosis, suggestive of certain environmental factors contributing to illness onset in these patients. In contrast, other MSA groups, including anti-MDA5, anti-TIF1, anti-NXP2 autoantibodies and MSA-negative JDM groups, did not exhibit seasonality in onset or diagnosis. In contrast to non-US cohorts, the frequency of anti-MDA5 autoantibodies over time has not increased over the past three decades and did not differ compared to anti-TIF1 and anti-NXP2 autoantibody-positive groups.

Health Sciences

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ABSTRACT

The Effects of Non-Pharmacological Interventions Consisting of Earplugs and Eye Masks, Reducing Environmental Factors to Improve Self-Reported Sleep Quality in ICU Patients

Intensive Care Units (ICU) are noisy environments that hinder sleep. Sleep disruption may have negative affect ICU patients' recovery.

The aim was to determine the feasibility, patient's comfort level, and the effects of ear plugs, eye masks, and limiting nursing interventions on self-reported sleep quality during ICU stay.

This quality improvement project was conducted in a community hospital using a quasi-experimental design. Patients in the intervention group wore earplugs and eye masks with limited nursing interventions during nighttime hours compared to patients in the control group who received routine care. Patients subjective sleep quality was measured using a validated sleep scale and open-ended questions were used to assess factors that effected sleep.

38 patients (21 in the control group, and 17 in the intervention group) participated in the project. No statistically significant differences were found between groups. However, the effect sizes were moderate for several sleep items, showing that patients in the intervention group reported higher quality of sleep than those in the control group. Patients reported that ear plugs and eye masks were comfortable and improved their sleep. Both groups reported that noise, equipment, and nursing intervention were factors that hindered their sleep.

Our study demonstrated that non-pharmacological interventions had a clinically meaningful, moderate effects in improving ICU patients' sleep in the first 24-48 hours. Using ear plugs and eye masks, and controlling environmental noise are low-cost strategies that can improve sleep in ICU patients

Health Sciences

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ABSTRACT

The Effects of Diabetes Self-care Management Education Paired with Behavior Change Support Program Using Mobile Technology in Improving Disease Knowledge, Self-care Activities, and Health Outcomes in Adult Type II Diabetes

Research has shown that Diabetes Self-care Management Education (DSME) paired with the Behavioral Changes Support Program using Mobile Technology (BCSP-MT) has improved patient outcomes for diabetes care by promoting self-care activities. It was noted that many primary practices do not provide BCSP-MT to improve quality of diabetes care.

The purpose of this study was to assess the effectiveness of DSME paired with BCSP-MT in adult type 2 diabetes patients to improve health disease management knowledge, self-care practices, and diabetes control.

A three months, one-arm, pre-post pilot study of BCSP-MT was conducted in a clinic in the Northeastern U.S. A convenient sample of 14 adult type II diabetes patients with A1C 7.0% or above was recruited. The intervention consisted of 2 to 3 educational weekly text messages, 2 face-to-face meetings, and 3 monthly phone calls between the monthly DSME. The outcomes were measured by biometric data paired t-test (BMI, BP, A1C, & LDL levels) and the Diabetes Knowledge and Self-Care Activities scores at three-month marks.

11 people, who completed biometrics only, showed reductions in a BMI, A1C, LDL. There was a significant improvement in both diabetes knowledge (pre-5.79, post-12, $p=0.041$) and self-care activities scores (pre-28, post-36.29, $p=0.19$) with regard to the dietary regimen, foot care, exercise, and lifestyle behavior in 7 participants. Marital status, ethnicity, age groups, and education levels had a significant effect on the completion of the program.

Overall, biometrics of BMI, LDL, and A1C were reduced after BCSP-MT in 11 participants. Demographic factors should be considered when planning future practice or research for the quality improvement for diabetes. Further research on a larger sample with a randomized control with 3- and 6-months intervals would increase the cogency of the study.

Health Sciences

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ABSTRACT

A Systems Perspective for Integrating a Community-Based, Family Centered Nutrition and Exercise Program into a Preexisting Physical Extracurricular Activity

Childhood obesity continues to be a problem in urban areas despite an understanding of the causes and consequences. It is essential to develop ways to reduce childhood obesity from a systems perspective, addressing the multifaceted elements that contribute to it.

This project aimed to improve health outcomes and decrease long term complications related to childhood obesity within an urban city in New Jersey, by utilizing a systems perspective in the implementation and evaluation of a community-based, family-centered nutrition and exercise program.

A 12-week nutrition and exercise program was implemented using evidence-based materials from Let's Go 5210 to develop the curriculum regarding diet and activity. An evidence-based 10 item open-ended survey design was used to measure knowledge of healthy food behaviors and attitude towards a healthy lifestyle pre and post intervention. Anthropometric measurements were obtained at 0, 6, and 12 weeks to determine if there had been any changes from baseline. System level policy changes were implemented.

Evaluation of collected data for participants (N=42) was completed using a paired t-test. There was an increase in serving of fruits and vegetables, 95.2% ($p < 0.001$). There was a decrease noted in the number of fast food per week, 71.4% ($p=0.021$). Regarding number of sugary drinks per day, 71.4% noted a decrease ($p<0.001$). There was a decrease in the hours of screen time per day 78.5% ($p<0.001$). Finally, there was a noted increase in hours of active play 80.9% ($p<0.001$). A repeated measures ANOVA was conducted on weight and BMI data achieved statistical significance for BMI but not for weight; p-value 0.005 and 0.891, respectively. A reduction in weight and BMI, 42.8% and 23.8%, respectively was noted. Additionally, a partnership was developed with a farmer's market to provide vouchers to YMCA members and the facility's vending machines were restocked with some healthier food items.

Incorporating a nutrition and exercise program into preexisting extracurricular activities will encourage healthy lifestyle changes for families to combat childhood obesity. As a result, the Capital Area YMCA has adopted the program into the curriculum of the Dance Academy, with plans to implement into other after school programs at the YMCA. The study revealed the benefits of adopting a nutrition and exercise program into preexisting activities.

Health Sciences

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ABSTRACT

Interprofessional Initiative Assessment Measures: Preparing for a Global Team Engagement Pilot Study

Developing a pilot study with interprofessional colleagues from medicine, engineering, and technology can be challenging, and is further complicated when it is also a multi-site international study with different research standards and healthcare practices. In preparation for the pilot launch of the Global Network for Simulation in Healthcare's (GNSH) 30-Minute Weekly Initiative, an innovative program using patient stories to improve team engagement and patient safety worldwide, a theory-driven evaluation plan was constructed with evidence-based measures to assess the structure, process, and outcomes. This presentation describes the planned assessment process for the pilot study that will occur in healthcare organizations in the U.S., U.K., and Canada. The evaluation plan, based on the Donabedian Structure-Process-Outcomes Model, assesses the structure and process of the program through usability, feasibility, and team engagement metrics, previously used in healthcare research. The priorities of the pilot study are to determine program ease of use, feasibility, organizational readiness, and effects on team engagement, while maintaining awareness of survey fatigue and respecting participant and facilitator professional time. Participants, facilitators, and the program will be assessed through first-click testing, surveying participants and facilitators at defined points during the initiative, and facilitator interviews conducted by experienced debriefers. These measurements originated from research across healthcare professions and industry, and also evolved from interprofessional collaboration with experts in the field, including comparison with the clinical and systems discussion topics within each Team Engagement session.

By the end of this presentation, learners will be able to:

1. Describe the Donabedian Structure-Process-Outcomes Model as it applies to developing an evaluation plan.
2. Discuss evidence-based measurements that assess usability and team engagement.
3. Understand facilitators and barriers to creating metrics in an interprofessional and international healthcare team.

Health Sciences

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ABSTRACT

Time for Quiet: Reducing Nighttime Interruptions in the ICU (TURN IN-ICU)

Undisturbed, restful sleep is essential for physiological as well as psychological well-being. For critically ill patients, sleep deprivation caused by frequent nighttime interruptions is associated with poor sleep quality and negative patient outcomes.

The purpose of this Quality Improvement (QI) project was to promote uninterrupted sleep between the hours of 10 PM and 5 AM. Outcomes for evaluation consisted of the following three components: (1) sleep quality, (2) incidence of delirium, and (3) nighttime sedation requirements. Except for sleep quality, these variables were compared before and after the intervention.

A descriptive, before and after design for data collection and analysis was utilized. Quantitative data was obtained via the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU), and the Richards-Campbell Sleep Questionnaire (RCSQ). The nurse-driven, non-pharmacological ICU Sleep Checklist contained nine interventions reducing noise, light, and iatrogenic sleep disturbances.

Seventy-four patients received the intervention and completed the RCSQ. For all RCSQ items, patients scores indicated a tendency towards a favorable (mean, [SD], 51.78, [24.64]) and perceived nighttime noise levels were low (73.58, [26.93]. No incidences of ICU-acquired delirium were noted. A chi-square test determined a statistically significant relationship between CAM-ICU scores pre- and post-intervention ($p < .05$). A single sample t-test was conducted to determine if a statistically significant difference existed between sleep quality scores in patients receiving the nonpharmacological sleep interventions. Statistical significance was noted in the categories of "awakenings" ($t=3.08$, $p < .05$) and "noise" ($t=3.08$, $p < .05$). The overall score suggests a trend toward satisfactory sleep quality.

We identified an association between people who report better sleep quality and those who receive less medications during the night. An improvement in the rate of ICU delirium in this population suggests that by promoting sleep, ICU nurses can prevent the onset of delirium. It is feasible to apply this intervention with a minimal amount of extra work for nurses. An improvement in the rate of ICU delirium in this population suggests that by promoting sleep, ICU nurses can prevent the onset of delirium.

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ABSTRACT

Provider Perceptions of the MY WAY Intervention: Implementing Advanced Care Planning in CKD Clinics

Patients with chronic kidney disease (CKD) benefit from integration of advance care planning (ACP) into their care, and many patients report wishing they had engaged in ACP before the dialysis decision. The MY WAY trial randomized participants from four CKD clinics in the eastern United States to receive printed ACP materials or printed materials plus an ACP coaching session that used motivational interviewing. We interviewed providers at each site to gain insights into the impact of the intervention on clinic workflows and patient outcomes as well as challenges and facilitators to implementation.

Telephone interviews were conducted with clinical providers and research staff at each intervention site. We invited principal investigators, ACP coaches, and research staff. The semi-structured interview used open-ended questions to elicit personal impressions as well as perceptions of clinic-wide responses, changes in workflow, and intentions for future use of the intervention. Interviews were audio recorded, transcribed, and analyzed using Dedoose software. Grounded theory was used to identify patterns and discover core concepts and categories.

12 participants were interviewed between September 2019 and November 2019. Participants from all four clinical sites included three nephrologists, one palliative care doctor, three ACP coaches (two social workers, one nurse practitioner), and five research staff. The intervention was well-received; providers were overwhelmingly in favor of integrating ACP into CKD care. The interviews revealed themes as to what inhibited or encouraged integration. Some major obstacles were lack of time, provider discomfort/lack of training, and a need for dedicated staff for ACP. Despite varied perceptions of issues with recruitment, providers reported positive patient reception of the MY WAY intervention.

Interviews with clinical providers revealed positive reactions to an ACP coaching intervention at diverse sites. Qualitative analysis provided insight into the possible future implementation of aspects of the MY WAY intervention as part of ACP integration into CKD care. The themes revealed in this analysis can guide conversations within CKD providers about how to resolve obstacles to integrating ACP into care.

HIV/AIDS

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ABSTRACT

RIG-I/MDA5 Agonists as Latency Reversing Agents for HIV

The major barrier towards curing Human Immunodeficiency Virus (HIV) is the virus' ability to create a reservoir of latently infected CD4T cells. One of the strategies to target this latent reservoir is referred to as "shock and kill". In this strategy, latently infected cells are "shocked" with a latency reversing agent (LRA), prompting the cells to start transcribing and producing HIV virus. This allows the immune system to recognize and "kill" the reactivated virus, with the goal of eradicating HIV completely. In this study, we investigated two Pathogen Recognition Receptors (PRRs) as potential new targets for the development of LRAs: retinoic acid-inducible gene I (RIG-I) and melanoma differentiation-associated protein 5 (MDA5). We hypothesized that activation of these PRRs would reactivate latent HIV through the adaptor protein mitochondrial antiviral signaling protein (MAVS) in an NF-κB-dependent manner. To explore this hypothesis, we used the cell line JLAT10.6, a Jurkat-based cell line containing an integrated HIV-1 genome that expresses GFP upon viral reactivation. JLAT10.6 were treated with various RIG-I/MDA5 agonists. Then flow cytometry was performed to assess GFP expression levels indicating reactivation of HIV. We further explored whether agonist coated nanoparticles would enhance delivery into the cells. For that, we coated Prussian blue nanoparticles with the RIG-I/MDA5 agonist poly(I:C), which functions as a synthetic analog of double stranded RNA. Our work indicated that poly(I:C) reactivates latent HIV in JLAT10.6. Furthermore, Poly(I:C) coated nanoparticles greatly increased viral reactivation in comparison to free poly(I:C), indicating increased cytoplasmic delivery and a promising new application of nanoparticle use to deliver cargo to intracellular targets. Our study provides insight into the use of poly(I:C) as a latency reversal agent combined with nanoparticles as a potential method of delivery.

HIV/AIDS

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ABSTRACT

Characterizing the Target of the Novel STAT SUMOylation Inhibitor HODHBt

While HIV has become a treatable, chronic disease thanks to current antiretroviral therapies (ART), the largest barrier to developing a cure remains the latent reservoir formed by virus going transcriptionally silent in infected cells. Shock and kill strategies rely on the use of latency reversing agents (LRAs) to reactivate the dormant virus so that the infected cells can be cleared by cytotoxic lymphocytes and other immune cells. Signal transducers and activators of transcription (STATs) are key components of the JAK/STAT signaling pathway which is heavily involved in regulating the transcription of anti-viral genes in response to infection. Our lab has identified a small molecule, HODHBt, that inhibits SUMOylation of STAT5 leading to increased STAT5 activation and reactivation of latent HIV. While the effects of HODHBt on latent HIV have been well characterized, its exact target remains unknown. Here, we begin to investigate the potential target of HODHBt using multiple biochemical assays. To select our candidates, we first performed mass spectrometry on protein targets identified using an immobilized analogue of HODHBt coupled to polystyrene beads. Second, we selected known members of the SUMOylation pathway. To address whether any of these are the potential binding partners of HODHBt, we used the Cellular Thermal Shift Assay (CETSA) which measures thermal stability of proteins upon ligand binding. We compared the thermal stability of our candidates in the presence of HODHBt or an inactive analogue. Using this assay, we identified two proteins where thermal stability was increased in the presence of HODHBt. We have also optimized a reporter cell line to measure STAT5 activity promoted by HODHBt and other analogues. Using this cell line, our next step is to knock down using either siRNA or CRISPR/Cas9 these candidates to further characterize the role of these proteins in controlling STAT5 function. By combining these assays into a single workflow, we have developed a biochemical tool for discriminating between viable candidate proteins to further study. Identifying the target of HODHBt will allow us to pursue a broader range of functional assays to study the role of this protein on HIV latency as well as in the biology of STAT activation in controlling other cellular processes such as antiviral responses, immune regulation or cancer.

HIV/AIDS

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ABSTRACT

Hepatitis-C Care Outcomes and HCV Reinfection among HIV Patients in An Urban Clinic Setting in Washington, DC

Hepatitis-C virus (HCV) causes infection of the liver and is a common comorbidity for people living with HIV (PLWH) because of shared risk factors, namely intravenous drug use. The natural history of HCV-related liver disease among HIV patients is accelerated even among those with undetectable HIV viral load. Prior research indicates that those with a HIV/HCV coinfection have a higher risk of death for non-AIDS-related death than for an AIDS-death. The biggest challenge in treating HIV/HCV co-infected patients is choosing an ARV-DAA medication regimen with the least amount of drug-drug interactions.

To describe the relationship between the clinical characteristics of HIV/HCV coinfected patients and referrals to behavioral health, case management, and substance abuse at an FQHC in Washington, DC.

Existing "DC Cohort" patients (n=734) with HCV were identified (n=143) that fit the inclusion criteria for the diagnosis of HCV. Data on demographics and clinical characteristics was exported and analyzed using SAS. Referral data was manually collected from an EMR review for each eligible patient.

Results show that intravenous drug use and smoking are significantly associated with HIV/HCV coinfected patients, while alcohol abuse is not significant associated. Of the 143 coinfected patients, only (n=72) 50.35% have a record of ever receiving DAAs, of which (n=61) 42.66% are cured. Patients cured with DAAs are more likely to have had behavioral health encounters than those cured without DAAs. There were 4 patients that were re-infected with HCV.

In-house behavioral health services are associated with better clinical characteristics among HIV/HCV patients at this clinic. Patients that received in-house case management and substance abuse services did not see a difference in their clinical characteristics. Greater consideration needs to be placed for substance abuse services for coinfected patients given the associated risk factors of intravenous drug use and smoking.

HIV/AIDS

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ABSTRACT

Targeted Emergency Department Screening for Pre-Exposure Prophylaxis Use May Increase Uptake Among Individuals at High Risk of HIV Acquisition

Pre-exposure prophylaxis (PrEP) is an effective method to prevent HIV acquisition in high risk individuals. In 2017, CDC estimated that approximately 10% of the 1.1 million high-risk individuals who could benefit from PrEP were prescribed it. Disparities exist in PrEP uptake with high risk racial/ethnic minorities and heterosexual women less likely to be prescribed PrEP. Emergency department (EDs) serve a substantial proportion of patients at high risk of HIV acquisition and may be able to play an important role in PrEP awareness and uptake.   This study assessed indication for PrEP use, awareness and attitudes among patients who presented to two EDs with chief complaints indicative of HIV risk.

Research assistants screened adult patients who presented to two hospital EDs during a 6- month period with a genitourinary, sexually transmitted infection (STI), or substance use-related complaint. Patients with these complaints who reported they were sexually active within the past 6 months and were HIV negative were asked to complete a computer-assisted survey that included questions on sexual practices and partners, substance use and attitudes and knowledge about HIV and PrEP. We used the CDC clinical guidelines to determine whether PrEP use was indicated. We compared differences in PrEP use indication by demographic characteristics, knowledge and attitudes using a chi-square test of homogeneity.

Of the 406 participants, the median age was 27 and the majority were black (85%), heterosexual females (72%), and employed (66%). PrEP use was indicated in 17% (N=68), most commonly because participants reported condomless sex with a person of unknown HIV status (82%) and/or an STI diagnosis (44%) within the past 6 months. Only 20% with PrEP use indicated perceived their HIV risk to be medium to high. The majority of those with PrEP use indicated were heterosexual females (54%) and males (35%). There were no significant differences in PrEP knowledge by whether PrEP use was indicated. However, those who met PrEP use indications were significantly more likely to state they wanted to learn more about PrEP (56% vs 32%, p=.0001) and were willing to take PrEP (50% vs 21%, p=.006) compared to those that did not.

The ED may be a useful venue to perform targeted screening, education and referral for PrEP among individuals at high risk of HIV acquisition.

HIV/AIDS

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ABSTRACT

Comparative Analysis of Black Women on Pre-Exposure Prophylaxis (PrEP) in Maryland and Alabama

Black women account for 59% of HIV incidence among women and 11% of all HIV incidence within the United States and its territories, but only make up 19% of the population. In 2017, HIV incidence was 231 cases in Maryland and 102 in Alabama for Black women. In 2012, the U.S. Food and Drug Administration approved Truvada™ as PrEP. This analysis reviews the impact of health insurance regarding PrEP access in Maryland and Alabama.

This retrospective comparative analysis of HIV-negative Black women on PrEP in Maryland and Alabama used publicly available CDC and AIDSvu data. An analysis of healthinsurance.org data yielded the impact of Medicaid expansion due to health insurance access and PrEP utilization. PrEP-to-need ratio (PnR) formula calculated need. Review of the social determinants of health that affect Black women's access to proper healthcare. A literature review of clinical best practices to increase PrEP uptake helped provide recommendations.

In 2016, 1,146 women filled PrEP prescriptions, 297 were Black. PrEP uptake rate for women is 2.3 users per 100,000. Black women are 4x less likely to use PrEP. The rate of PrEP uptake for Black women is 2.3/4.0 = .575 per 100,000. The rate of women utilizing PrEP in Maryland was 7 per 100,000 and 3 per 100,00 PrEP users in Alabama 2017. The rate of Black women on PrEP yielded 4 per 100,000 in Maryland and 1.73 per 100,000 in Alabama. PnR for Black women is 7/28 = .25 per 100,000 in Maryland and 3/18 = .17 per 100,000 in Alabama. 16.1% of Black Alabama women are uninsured that is almost double the 9.6% of uninsured Black Maryland women. PrEP without insurance costs $1,600-2,000 monthly and $19,200-24,000 annually. Median salary for Black women is $30,003 in Alabama and $49,504 in Maryland. Maryland has more Black women on PrEP than Alabama primarily due to Medicaid expansion.

Black women in Alabama experience more barriers to accessing PrEP based on Medicaid access. More research and advertisements on PrEP uptake is needed for Black women. Education on PrEP availability through programs like Ready, Set, PrEP, TelePrEP, and Healthvana is needed. Doctors should incorporate PrEP discussion into sexual reproductive health screenings. Accessing HIV services needs to be destigmatized to increase PrEP acceptability. Research limitations encountered were that Alabama did not have readily available HIV surveillance data since 2017 or data on PrEP uptake.

HIV/AIDS

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Hana Akselrod

ABSTRACT

Evaluation of Barriers to Antiretroviral Therapy among People with HIV in Washington, D.C.

Washington, D.C. has one of the nation's highest rates of HIV infection, at ~1.8% of the general population, with historically disadvantaged communities disproportionately affected. Successful management of HIV necessitates patient engagement beginning with testing and diagnosis, followed by linkage to care, retention in care, and adherence to antiretroviral therapy (ART). We conducted a cross-sectional study exploring individual-level and structural barriers to ART initiation and continuation.

Fifty patients (of target N=200) with diagnosed HIV, who were either not taking ART at the time of enrollment or had a documented history of non-adherence in the past 3 years, completed questionnaires during structured interviews at the George Washington University hospital or Infectious Disease Clinic. De-identified data was entered into REDCap. Interim statistical analysis was conducted using Chi-Square tests.

 The median age of the 22 hospital and 28 clinic patients was 43.9 years (range 26-66); 56% were male, 92% were black and 55% were heterosexual. Patients believed they acquired HIV through sex with opposite-gender partner (40%), sex with same-gender partner (38%), and IV drug use (10%). Participants reported a history of homelessness, arrest/incarceration, or mental health diagnosis, at 49%, 60%, and 57%, respectively. The vast majority (92%) were referred for HIV care, 90% had seen a doctor, and 86% started taking HIV medications but later discontinued. Major reasons for discontinuing ART, reported as "agree" or "strongly agree," included high pill burden (53%), fear of stigma (48%), side effects (44%), illness from other medical conditions (42%), mental health (40%), feeling healthy (38%), and alcohol/drug usage (36%). Surprisingly, issues with insurance, cost, doctor trust and understanding how to take medications were less important. Also, many participants indicated additional barriers to ART besides those included in the survey, such as family illnesses and travel. Although preliminary Chi-Square analyses did not result in statistically significant associations, adding more participants may reveal differences between interview sites and other demographics in the roles of stigma, mental illness and medication side effects as barriers to ART.

HIV/AIDS

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ABSTRACT

Polymeric Nanodepots Enhance Primary Natural Killer Cell Antiviral Function

Adoptively transferred natural killer (NK) cells represent a promising immunotherapeutic strategy in infectious disease, HIV, and cancer. As the primary mediators of antibody-dependent cellular cytotoxicity (ADCC), many groups examine the effects of infusing NK cells into patients to improve a cytotoxic immune response against target cells. This approach relies on the intrinsic function of NK cells without selectively targeting cells of interest, and thus may be inefficient or generate off-target effects. Boosting specific NK cell cytotoxic function may hold the key to improved NK cell-based therapies. Here we present a novel nano-immunoengineering approach to improve NK cell effector function. Specifically, we have generated a nanodepot (ND) platform that packages an agent to activate target cells (prostratin) and an activation- and target cell-specific antibody (anti-CD25). Administration of the NDs in combination with NK cells as an ensemble therapeutic co-localizes the actions of the three components, wherein prostratin activates target cells, causing CD25 expression on their cell surface. Subsequently, anti-CD25 binds to the target cells, and NK cells are then stimulated to effect ADCC via this specific binding interaction. We hypothesize that the co-localization of these functions will trigger a coordinated eradication of target cells. Here, we present the physiochemical characterization of the NDs and confirm feasibility of the therapeutic approach in a cell model of latent HIV. Nano-emulsion was used to manufacture stable poly lactic-co-glycolic acid (PLGA) NDs (~250 nm) that encapsulate both prostratin (39.2 µg/mL) and anti-CD25 (48.9 µg/mL). When administered with primary NK cells, the NDs appear to enhance NK cell function, leading to decreased target cell viability. By packaging different agents and antibodies in the NDs, this platform can be customized for effective nano-immunotherapeutic solutions in many cancers and other diseases.

HIV/AIDS

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C. Russell Cruz

ABSTRACT

Genetically Modified HIV Donor Derived NK Cells Secrete Broadly Neutralizing Antibodies: A Novel Approach to Cure HIV.

Antiretroviral therapies have improved the survival of patients with HIV/AIDS, but they do not lead to elimination of the virus. As a cure strategy, we have previously generated HIV-specific T cells genetically modified to secrete broadly neutralizing antibodies (bNAb); however, infusion of a heterogenous population of T cells including CD4+ could potentially provide a new reservoir for HIV infection and replication. Thus, we sought to translate this platform to cells not be susceptible to HIV infection - natural killer (NK) cells. We hypothesized that spatio-temporal co-localization of NK cells and bNAb, through the genetic modification of HIV+ donor derived NK cells to secrete bNAb, would have potent antiviral efficacy against HIV-infected T cells.

NK cells were expanded from five HIV+ donor peripheral blood with K562 feeder cells and cytokines, and transduced with a 10-1074 antibody construct. Following transduction (50.78 16.11% transduction efficiency, n=5), NK cells secreted highly varied levels of 10-1074 antibody (375.44 545.82 ng/mL, range: 10.23 ng/mL to 1.17 ug/mL, n=4) into the cell supernatant. Transduction and secretion of 10-1074 antibody had no significant effect on 7-day NK cell fold expansion, expression of activation markers CD25 and CD69, expression of exhaustion markers TIM3 and PD1, or cytotoxicity against K562 cell line. In an in vitro viral suppression assay, where autologous CD4+ T cells are activated and infected with HIV, transduced NK cells displayed greater viral suppression compared to their untransduced counterparts (NK at 5:1 E:T, p24 level normalized to HIV infected CD4+ T cell alone: 41.95 35.45% p24 Untrans, 2.18 2.52% p24 Td 10-1074 Ab, n=3).

In summary, we have shown (i) NK cells can be transduced with a 10-1074 broadly neutralizing antibody construct, (ii) transduced NK cells are able to secrete 10-1074 antibody, though significant variation was observed between donors, and (iii) transduced NK cells significantly reduce levels of HIV p24 in an in vitro virus inhibition assay (p=0.0005, p=0.0021, p=0.0051 per donor). These initial results suggest that HIV donor derived NK cells genetically modified to secrete 10-1074 Ab have enhanced antiviral efficacy against HIV infection.

Humanities

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ABSTRACT

Bootylicious: The Reclamation of Black Femininity and Sexuality

This poster presentation reviews the ways in which Black womxn's femininity and sexuality has been policed and restricted under the white gaze (womxn being used to include Black transwomen). The research addresses how Black womxn's bodies have been dehumanized, over-sexualized, and burdened with negative stereotypes that have affected the way in which they express their femininity and sexuality. The hypothesis argues that Black womxn have worked to reclaim and redefine their femininity and sexuality, thus creating their own standard. Using the theoretical frameworks of Hip Hop feminism, Black feminism, and Trans feminism, this research seeks to understand how Black womxn are developing a framework for understanding Black femininity and sexuality, while disrupting Eurocentric beauty standards and respectability politics. This framework is centered in healing, loving, and reimagining the Black body. The qualitative research method used is case studies of three Black womxn that are transforming the way we engage with Black femininity and sexuality. This analysis is intended to end the policing of Black womxn's bodies by showcasing how it contributes to the systematic oppression of Black womxn, while providing a framework built by Black womxn to understand Black femininity and sexuality.

Humanities

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Dane Kennedy

ABSTRACT

Caught in the Middle: The Accession of Kashmir and Hyderabad after the Independence of the Indian Sub-Continent

The moment of partition and independence on the Indian subcontinent transformed the British Raj into newly created states. This raised the question of what to do with the princely states. The princely states were kingdoms that were given semi-autonomous status within the Raj and were in many cases used by the Mughal Empire in a similar way. The relatively tiny British administration in India was greatly aided by the support of the princely states. They were integral parts of the British Raj and even helped administer regions that were under direct British rule, playing key roles in events like the Indian Mutiny of 1857. There were 565 princely states which altogether controlled about 40% of the Raj. Post-independence, 562 of them were acceded into the newly independent states of India and Pakistan without conflict. One of these three exceptions was solved through a plebiscite. The other two, Kashmir and Hyderabad, became major issues for India's nascent government. These two princely states were territorially large, populous, and influential, which led to a more complex process of accession than for the smaller princely states. My research focuses on the accession of Kashmir and Hyderabad to India. The fates of these two princely states were not only affected by the bilateral relations between their leaders and the Indian central government but also the geopolitical balance of power between India and Pakistan within the context of the Cold War. This study will primarily be done through the Correspondence of Sardar Patel, who was not only the first Minister of Home Affairs but also the first Commander-in-Chief of the Indian Armed Forces.

Humanities

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ABSTRACT

The Washington Family and Native American Slavery

This paper was inspired by the lack of attention to Native American Slavery during the Colonial Period. Additionally, this project birthed from the fact that George Washington's Mount Vernon Estate had once belonged to the Doeg, a Native American tribe that would soon be displaced by Northern Neck Virginia colonists. The main aim of this project would be to examine how the Washington family played a role in perpetuating Native American Slavery during the early seventeenth and eighteenth centuries. More specifically, this paper focused on the enslavement of Native Americans in Potomac Country area which included the Powhatan, Susquehannock, Doeg, Seneca, and Pamunkey.

Examining the overall historiography and geography of the Potomac Country and the interactions between the indigenous people and colonists help contextualize and highlight the Washington's involvement in the encroachment of Native American territory. George Washington's great grandfather, John Washington, became part of the elite colonial Virginia community and established the Washington family as part of the famous Northern Neck Dynasties who seized Powhatan and Pamunkey territory. This paper also documents John Washington's gradual procurement of Native American land as revealed in his land patents with other prominent landowners. In connecting the common themes of encroachment of land and slavery, this thesis provides a comprehensive overview of the legality of Indian slavery spanning from the early seventeenth century until Bacon's Rebellion.

As a result of these processes, this thesis ultimately found that as a result of John Washington's involvement in land expansion of northern Virginia into Indian territory and the Virginia House of Burgess, he indirectly contributed to the triggers of Bacon's Rebellion, institutionalized indigenous enslavement, and established the legacy of the Conotocaurius, also known as Devourer of Villages, throughout George Washington's presidency. Part of John Washington rise as an elite Virginian included having a position in the local government as well as the county militia. His new found position required him to be present during the passage of the Baconite law legalized the enslavement of Native American prisoners of Bacon's Rebellion. His involvement as a local militia provided him with the platform to justify murdering the Doeg and Susquehannock, thus establishing a horrible legacy for his great grandson George Washington. Ultimately, this paper displays how Native Americans' land and labor had a pivotal role in shaping colonial Virginia and the legacy of the Washington family.

Humanities

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ABSTRACT

The Influence of Human Rights in Foreign Policy towards Guatemala under Nixon & Ford versus Carter

The Bay of Pigs Invasion in Cuba and the CIA coup against Salvador Allende in Chile are the most well-known acts of American intervention in Latin America during the Cold War. However, American action in this region was much more extensive than these two examples and just as devastating in other countries. Guatemala is a perfect example of this. In 1954, a CIA-backed coup removed democratically-elected president Jacobo Árbenz Guzmán from power and replaced him with a military junta. A series of coups followed, leading to a bloody civil war that ensued for 36 years. In this small country, it is estimated that as many as 200,000 people died during the war, many of whom were civilians slaughtered by the military or government security forces. In particular, during the second half of the war, many atrocities occurred, specifically the genocide of the Maya Ixil people.

The worst human rights violations in Guatemala occurred during Ronald Reagan's presidency; however, not enough documents are declassified to investigate Reagan's influence. As a result, my research focuses on three other presidents who were in office during the Guatemalan Civil War: Nixon, Ford, and Carter. My thesis analyzes the influence of human rights in foreign policy towards Guatemala during the Nixon & Ford administrations compared to the Carter administration. It focuses on two aspects: how they portrayed themselves publically versus the actions of their administrations. Carter presented himself as a staunch supporter of human rights, while Nixon & Ford publicly emphasized American security as the top priority. While all three presidents did continue to aid the Guatemalan government, Nixon & Ford were actually more wary of their support for a country with a poor human rights record than Carter was, even though Carter is placed on a moral pedestal.

My research demonstrates that presidents are able to convince the public of their priorities, no matter the actions that occur out of the public eye. Further, a president's legacy is largely created by this public facade, not their actual foreign policy decisions, even if this image is not accurate. While it is not uncommon for the United States to only consider American interests when intervening in the domestic affairs of a country, Nixon, Ford, and Carter's actions in Guatemala demonstrate the negative consequences that these interventions have on local populations.

Humanities

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ABSTRACT

Modern Prophets: The Re-Enchantment of Data Sciences

On November 10, 2016 Steve Lohr and Natasha Singer of the New York Times published a retrospective on the unexpected failure of forecasting models to predict President Donald Trump's election day success. "It was a rough night for number crunchers," writes Lohr and Singer. "And for the faith that people in every field — business, politics, sports and academia — have increasingly placed in the power of data." Of particular interest is Lohr and Singer's use of the word "faith" to denote the relationship the public has with forecasters. The word "faith" implies confidence (i.e. to 'have faith in'), but also devotion (i.e. to 'keep faith with' or 'be faithful to') that is not typically associated with the data sciences of post-Enlightenment rationalism. In this paper, I argue that the religious overtones of terms like "faith" point to the mythical status which the data sciences have taken on in contemporary Western societies. As a result, modern prognosticators have been given the standing of pre-Enlightenment prophets and fortune-tellers common among religious and para-religious communities prior to Europe's seventeenth and eighteenth century turn to reason. Data sciences and the experts charged with interpreting data have, I argue, undergone what Theodor Adorno and Max Horkheimer call an insidious "re-enchantment," which has hidden the inner workings of forecasting models from public view, and created a group of expert interpreters who act as political mediators — alienating the public-at-large from politics, and helping to perpetuate capitalist power structures.

I begin with Silvia Federici historical account of the decline of magic under capitalism and prophecy's replacement with found in statistics, demography, and other data sciences during the sixteenth and seventeenth centuries. To make her argument, Federici draws on Max Weber's theory of "disenchantment" — a historical process through which the natural world and the human condition have come to be experienced and understood as less magical. In response to Weber, Theodor Adorno and Max Horkheimer argue that an insidious "re-enchantment" acts alongside and complements the disenchantment process, imbuing institutions of power like money, labor, commodities, and consumerism with a mythical aura that protects them from criticism and encourages the public to 'trust the system.' I argue that modern data sciences have been similarly re-enchanted. To bolder my claim, I evaluate common examples of "behind-the-scenes" data analysis — such as personality tests and political commentary — and what they claims to reveal about the future.

Humanities

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Denver Brunsman

ABSTRACT

"America, A New Rome:" Roman Republican Influences on Early American Republicanism and the Foundation of the American Capital.

This project uses primary Roman and American sources to explore the influence of the Roman Republic on the early American political and geographical world with emphasis on American personal correspondences and writings. This study contributes to current scholarship by incorporating a close analysis of language and philosophy with the digital humanities.

While general similarities between the Roman and American Republics are obvious to modern scholars, 17th and 18th century historians, philosophers, and politicians held a different view of the Roman Republican world—one that simultaneously criticizes the late Roman Republicans for greed and praises the early and middle Roman Republicans for creating a hegemonic state. This research uses the digital humanities to visualize these opposing views through Social Network Analysis (SNA) of prominent early American statesmen and GIS mapping in order to demonstrate how American views differed based on education, location, and other demographic identifiers.

This thesis demonstrates how American statemen used primary Roman Republican texts and laws to draft the new American government. Such texts and laws, including the Roman's unwritten guidance of mos, translated into the American world by instilling Roman traditions on a population well-versed in the classical world. America's familiarity with Latin (from the limited subjects taught in school and the revival of neoclassical fascination) significantly contributed to the creation of the new country's physical space and the workings of Roman imagery in everyday life. This research argues that early Americans depended heavily on the government and urban development of the Roman Republic to provide guidance for the new state—through both written sources and early archaeology of Rome.

Humanities

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ABSTRACT

The Educating Artist: Schiller's Lasting Message of Political Freedom in German Theater

Johann Christoph Friedrich Schiller (1759-1805), German poet and playwright, began his career with a call for revolution and culminated his career with a call for restraint. Metaphorically imprisoned by the military school he unwillingly attended, the authority of the ruling duke of Württemberg, Karl Eugen, and recurring illness, Schiller wrote Die Räuber, a controversial, provocative play which put the values of the Storm and Stress period on full display: rebellion against authority and establishment, condemnation of corruption, and the call for freedom. The revolutionary impulses continued in Kabale und Liebe, which exposed the contemporary tyrannical abuses of power in a system that repressed and manipulated its citizens and gave them no access to due process. Inspired by the French Revolution, with its promises of Liberty, Brotherhood, and Equality, Schiller championed freedom from authoritarian despotism, but when the Reign of Terror caused heads to roll, Schiller retreated in horror.

The Reign of Terror caused Schiller to question whether revolutionaries were ready for leadership positions and if Germany was prepared to transition to a government of self-rule. Instead of continuing his call for revolution, Schiller began to instruct the citizens on the practice of responsible moral character, as seen in his ballads and his historical dramas, such as Maria Stuart and Wilhelm Tell. The consequences of the Reign of Terror also caused Schiller's philosophy to mature, ushering in his transition to the Classic Period.

In his Second Letter from On the Aesthetic Education of Man (1795), Schiller reacts to Kant's philosophy and highlights the erection of "true political freedom" as the "most perfect" of all works of art. In the Ninth Letter, Schiller highlights the "fine arts" as the instrument through which the character can be "ennobled." Schiller sought to harness the power of theater for educational purposes, using his plays to prepare the German speaking people for self-governance and political freedom: art as education.

This project explores Schiller's evolution between the Storm and Stress and Classic periods, looking closely at the promotion of political freedom in his plays, which he used to educate the German-speaking people and prepare them for independence and self-governance. This project combines traditional literary analysis of Die Räuber, Kabale und Liebe, Maria Stuart, and Wilhelm Tell with a creative take on Schiller's biography and my own experiences attending modern productions of Schiller's plays in Germany.

Humanities

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ABSTRACT

But, June, Some Of Us Did Die

For Black women, there is no separation between the personal and the political. Womanism, Black Feminism, Black Studies, Black Psychology, and Political Psychology have all been theorizing around the material reality of African Americans as well as the feelings associated with living that reality. The intersections of this dialogue have become an intellectual investment of mine. This essay interrogates the death and dying of Black women and girls, with a critical focus on "social death" to highlight the experiences and pain of those deemed disposable in a society largely through the construction of desirability politics ordered by Imperialist white supremacist capitalist patriarchy you are always close to death and eventually you will die. Interrogating "social death" requires examining death in terms a chokehold on joy, love, worthiness, and resilience-- while not erasing our literal deaths. This essay also takes also takes a critical focus on the sudicide deaths of Black (cis,trans,queer) women, investigating the white-black suicide paradox as we seek to defend the dead. My Black feminist intervention is to take social death seriously. I seek freedom and liberation for the Black women and girls who died first by social death and for those who are the walking dead believing there is an overwhelming uneven distribution of death missing from dominant discourses. Drawing from afro pessimism, psychoanalytic, womanist, and Black feminist theory this essay is apart of a long-standing tradition of storytelling from the margins to subvert our understandings of death, dying, pain, and radical love politics.

Humanities

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ABSTRACT

How to Establish a University Press that is Sustainable and Equitable

Markus Dohle, CEO of Penguin Random House says "this is the best time for publishing since Gutenberg." While other mediums such as cable television, magazines, and newspapers have struggled, the publishing industry, including books and journals, has evolved and adapted to the changing technological environment. University Presses are on the rise, with a 5% growth in sales from 2016 to 2017. The responsibility rests on them to produce not only entertainment but also to disseminate findings of the latest scholarship and research through published books and journals. Many industries have begun to shift toward more sustainable practices, and the publishing industry should be no different. Under the guidance of John W. Warren, Director and Associate Professor, Master of Professional Studies in Publishing, I will be addressing GW's vision for sustainability in the areas of environmental issues, equity and economic issues, and dissemination of educational resources in order to assist in establishing the George Washington University Press. The George Washington University Press is envisioned a teaching press managed and staffed by students dedicated to publishing and distributing high-quality works of scholarship that enhance the university's pursuit of knowledge. Through interviews with GW faculty and professors, we have found a need for editing and publishing services that can be most equitably sustained through the work of graduate students in the Master's of Professional Studies in Publishing. The environmental impact of a university press can be lessened by printing on recycled paper, which has been decreasing in price over the past couple of years, partnering with a local tree-planting organization to plant a tree per number of sales, and going digital-only for some publications to help reduce our University Press's footprint while addressing accessibility concerns. We also find that establishing an online journal dedicated to topics in sustainability will help fulfill our goal of disseminating high-quality works of scholarship while also being environmentally conscious and informative. Finally, partnerships with GW departments, groups, and faculty can help us promote community practice and collaboration. More and more industries are turning their attention to sustainability and publishing is no exception – publishing has survived 400 years, including periods of vast technological changes and uncertainty and it has the ability to thrive through a green revolution. Establishing a University Press from the ground up with sustainable practices in mind shows that other presses can do so as well with great success and longevity.

Humanities

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ABSTRACT

Vanishing Into Smoke: A Comparative Analysis of the Influence of The Federalist Papers on Constitution Ratification Votes in Virginia, New Hampshire, and New York

Although The Federalist Papers' cultural relevance for the general public has only recently been reignited by the musical Hamilton, they have been a prolific source on constitutional meaning for centuries. They are frequently cited by the U.S. Supreme Court in opinions, and they are especially helpful during turbulent political times when there are unexplored constitutional terrains, such as the recent impeachment proceedings. In short, their contemporary value is clear. What remains unanswered, however, is did delegates to the state ratifying conventions in the years of 1787 - 1789 ascertain the same value from The Federalist Papers? In other words, to what degree did The Federalist Papers influence delegates to state ratifying conventions and, overall, the ratification vote?

To help answer these questions, this study for my history honors thesis focuses on three states and their ratifying conventions: Virginia, New Hampshire, and New York. These states were chosen purposefully: New Hampshire was the ninth state to ratify, putting the Constitution into effect. Virginia and New York were large, influential states, and their support of the Constitution was crucial to its overall success. In all states, there were supporters of the Constitution and those who were opposed, making it appropriate to evaluate persuasive effects of The Federalist Papers.

Additionally, all three states proposed amendments to the Constitution, indicating that they weren't completely on-board with the finished product and needed convincing one way or the other. All three states were close in ratification time: New Hampshire on June 21, 1788, Virginia on June 25, 1788, and New York on July 26, 1788. The last Federalist essay was published on August 13, 1788. These indicate relationships between the states themselves and also the Federalist Papers.

The study is unique because it utilizes content-based analysis of ratifying conventions, personal correspondence of delegates, and the press in states to determine a relationship between The Federalist Papers and ratification. Other studies have looked only for specific references to The Federalist Papers, without analyzing the ideas included in The Federalist Papers, their publication dates, and these sources of "constitutional feeling." As such, this study is able to conclude that while The Federalist Papers' influence came in their 1) content; and 2) individual distribution among delegates in those three states. More specifically, they worked well in New York, for whom they were intended, moderately well in Virginia, who looked to New York for inspiration, and minimally in New Hampshire.

Humanities

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ABSTRACT

Pretty Little Stereotypes: How Pretty Little Liars Reinforces Conservative Ideals Through the Depiction of its Queer Characters

This is a rhetorical analysis of the television show Pretty Little Liars, arguing that despite its progressive depiction, it reinforces stereotypes and conservative ideals through the depiction of its queer characters. This research was conducted through the frameworks of Meaning Theory of Media Portrayal, and the Four Stages of Media Representation. This research includes an examination of a collection of episodes from Pretty Little Liars. Through analysis, three main pieces of evidence were found. First, the queer characters were subject to villainization, meaning that they were most often bullies, aggressors, and murderers. For example, coming out stories were often shaped through a negative narrative and used as a weapon. This research found that when queer characters were talking about coming to terms with their sexuality, it was often coupled with those queer characters inciting violence and bullying. Instead of queer characters being painted as vulnerable and emotional, they were painted as villainous, angry, and violent.

The second piece of evidence shown was that the queer characters were often subject to death, as they have been throughout television history. This researched showed that 4 queer characters, all who had major storylines, were killed throughout the show. This aligns with the overall pattern throughout history that queer characters are hardly given a happy ending in television and film. This emphasizes to audiences that identifying as queer does not result in a positive outcome, and that performing queerness is essentially met with death. The last piece of evidence this study found was that queer characters were often placed within homophobic stereotypes. These stereotypes include the same sex kissing just for practice and lesbians as serial daters. Kissing the same sex for practice is a common stereotypical trope and is displayed often in Pretty Little Liars. A bisexual character, Alison, kisses women and continues to denounce it as practice for men, despite her queer identity. This research also found that Emily Fields, a main character on the show who identifies as a lesbian, was only single for an average of three episodes, and this was a seven season show.

Overall, this rhetorical analysis proved that queer characters in television are often subject to severe homophobia and placed within conservative ideals. It emphasizes that not all representation is good representation, and that the simple existence of queer people in television does not mean that they are treated with the equal respect of their heterosexual counterparts.

Humanities

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ABSTRACT

The Ladies of Overlord: The Women's Army Corps & the Normandy Campaign

On 6 June 1944, Allied soldiers famously stormed the beaches at Normandy, marking the commencement of the Normandy Campaign. While much research exists surrounding this campaign, little scholarship highlights the participation of women, particularly members of the Women's Army Corps (WAC) in this military operation. In fact, many of the eminent publications about this campaign fail to even mention their existence. However, the WAC participated in both the planning and execution of this operation, as indicated through unit histories, after action reports, general correspondence, photographs, and oral histories. Members of the WAC worked with General Eisenhower and the Supreme Headquarters Allied Expeditionary Forces leading up to the invasion day and subsequently landed in Normandy throughout the summer months with various units, where the women contributed to a wide array of tasks.

Typically, the image of women during World War II focuses on their shifting cultural roles on the home front, excluding the immense change that occurred within the military. The creation of the WAC was the first time women could officially enlist in the United States Army, and operated on an entirely voluntary basis. This paper seeks to highlight the contributions made by members of the WAC in regards to the Normandy Campaign and the ways in which the WAC demonstrated their skill as enlisted personnel.

Humanities

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Arie Dubnov

ABSTRACT

The 12 Apostles: The Anglo-American Committee of Inquiry and its Decision Against Partition of Jews and Arabs in Postwar Palestine, 1945-1946

The subject of this thesis shall address the formation, membership, report, and reception of the Anglo-American Committee of Inquiry. The aim of this thesis is to determine why the Anglo-American Committee recommended against the partition of Palestine, when this had been the prescribed solution offered in previous and future proposals. It is suggested here that the Committee recommendation for a bi-national proposal was arguably the best recommendation that could have been issued under the circumstances. While the term best is itself subjective, it is held here to mean that the Committee was composed of capable members largely uninfluenced and uncorrupted, independent from outside pressure, attentive and receptive to the needs and sentiments of millions of peoples, unanimous in their decision, and heartfelt in its application. Most historians lambast the Committee for erring from the conventional recommendations, and some dismiss their entire existence under the shadow of the UN. It can be said that the Committee misinterpreted a local and temporary calm between Jews and Arabs during their visit to Palestine as an indication that long-term cooperation between both groups were possible, and felt that a bi-national proposal would be acceptable to a majority among the parties. Still, the Committee must be understood in the context of its time, and be given merit for their unique prescription. In their examination and defense, this paper seeks to clarify the reasons the Committee as a whole decided a bi-national proposal would be better than the alternative attraction of partition.

Humanities

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ABSTRACT

Abstract for Reconstructing the Nation: Images of East German Women and American Women in the Post-WWII Period and Nation-Building

In the aftermath of the Second World War, East Germany and the United States faced numerous challenges in rebuilding and demobilizing their countries. Both relied heavily on the labor of women to build and formulate new conceptions of their post-war futures. Despite vast amounts of scholarship on women in both countries, very little exists examining the way the state utilized images of women to create new ideals of womanhood in the period from 1949 to 1954. This study examines ten images, four photographs and one work of art from each country, that were either created or used by the governments of East Germany and America. An analysis of these images provides insight into how each government used the image of a fictionalized "woman" to draft new roles for women and place them into post-war society. It likewise challenges two commonly-held assumptions about women's roles in post-war nation-building: that women left the workforce after WWII and returned to the domestic sphere on a large scale, and that women are passive victims of conflict. The analysis of visual media provides a concrete example of how governments can create culture and write their histories and futures, often at the expense of "the truth" of those who are forgotten.

Humanities

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ABSTRACT

"Children for Sale": Bostonian Middlemen in the Northwest Coast Indigenous Slave Trade

Between the 1780s and 1840s, New England merchants streamed to the Northwest Coast of North America. Venturing around Cape Horn and up to the north Pacific in ships, brigs, and sloops, these "Boston Men" sold iron chisels, ship's biscuits, bread, molasses, and anything else they could scrounge up to the Nuu-chah-nulth, Haida, Heiltsuk, and other Indigenous people for sea otter pelts in return. Often amassing hundreds of pelts per voyage, they then carried these skins to the port of Canton (now Guangzhou), looking to buy porcelain, silk, tea, and other Chinese goods. Though joined by the Spanish, British, and Russians, Americans became the foremost non-Indigenous power in this maritime fur trade in the late eighteenth century.

While on the coast, some American traders trafficked enslaved Indigenous people between tribal nations in an effort to amass more otter pelts. These merchants, on vessels like the New Hazard and Hamilton, blended the long-held slaving practices of Northwest Coast Indigenous societies with their own financial ambitions. Most frequently, Indigenous people enslaved people from tribes they raided for territory or goods, and traded them to other groups as they would any other object. When they offered to sell people to American vessels, not every U.S. captain said yes, but a few chose to act as middlemen in this long-standing trade if it meant a greater supply of skins.

Not one historian has analyzed this American slave trafficking in detail, beyond brief mentions of it in works covering the greater maritime fur trade. This project maps out the characteristics of American involvement in this slave trade, the impetus for U.S. merchants to traffic, and the effects of this trafficking on the vessels' financial results as well as on the enslaved people themselves.

Humanities

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David Silverman

ABSTRACT

"Our Indian Brothers": An Analytical Study of 18th Century Moravian Missions in North America and The Individual Native People Living in Them.

When chronicling the tumultuous 18th Century, historians often relegate Native Americans to the margins. By examining the source base from Moravian church missions, which includes many firsthand accounts from Native people, I hope to shine a light on the lives of the related indigenous people as individuals. Native people of Lenape, Wampanoag, Mohican and other origins found homes in Moravian missions, often converting and adapting Christianity to their needs. Their voices combine with the accounts of white Moravians to fully capture the day-to-day lives of these mission towns. My research hopes to bring sources together and deduce key details about people often left out of historical study. To frame my argument, I rely on primary source documentation from Native people themselves whenever possible, comparing this to the documents of those who knew them, and I fill in the gaps with past secondary scholarship as needed. Through this lens it is possible to judge the viability of racially mixed communities of believers in Early America. In many ways Moravians reflected a deviation from the norm in their acceptance of Native religious practices and their commitment to helping the marginalized. Still, they cannot be fully separated from the broader history of colonialism and cultural contact in North America. It is my hope that this research does justice to both the significance of historical tragedy and the agency of the people experiencing it. The individuals whose lives I study cannot speak for everyone, but their struggles and stories deserve careful specialized study.

Humanities

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ABSTRACT

Familias Fragmentadas (Fragmented Families)

There exists a humanitarian crisis along the US-Mexico border. Daily, human rights abuses are committed. As a result of the immigration crisis and the great divide between the US and Mexico, families are splintered. This paper will analyze current literature however, it will note that the border has long resulted in family fragmentation. It is inspired by my mother. This past year, my mother met her biological family, revealing that her adoption was fraud. In brief, her biological mother crossed the border to give birth with a midwife in Texas, and after, the child, my mother, was born, the midwife told her that my mother was dead. As a result, my mother was adopted by US citizens, her culture and family robbed from her.

The purpose of this research paper is point to how literature reflects the lives of persons living within fragmented families along the US-Mexico border and how they deal with the loneliness and confusion that the experience causes. The thesis will be broken into three sections: Solitude, Confusion and Rehabilitation. Within these sections, literary devices will be analyzed and the pieces will be connected and compared through these underlying themes. To further link the various pieces of literature, the work of Elias Canetti, Edward W. Said and Gloria Anzaldúa will be discussed to highlight the similarities and differences among the literature throughout the three sections, joining them together. These scholars will help to understand the experiences of the characters by underlining the reasons the characters left their homes, what it means to be exiled, and history, poetry, and prose based around the cultural divide. Through this study, it will be understood how literature reflects the realities of family fragmentation, an ever more important subject matter as rhetoric surrounding immigration worsens and human rights along the border are abused daily.

The literature to be analyzed vary from young adult fiction to memoirs and are as follows: Desterrados by Eduardo Parra (2013), De donde venimos by Osar Cásares (2018), La línea se convierte en río by Francisco Cantú (2018), El libro de los americanos deconocidos by Cristina Henríquez (2014), and Desierto Sonoro by Valeria Luiselli (2016).

Humanities

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ABSTRACT

Aesthetic Theory and Theatrical Practice: Sergei Tret'iakov's Role in Redefining Art in the Early Soviet Union

Sergei Mikhailovich Tret'iakov (1892-1937) was a prominent Futurist literary critic, poet, and playwright in the Soviet Union. He co-edited the radical journal Novyi LEF with fellow writer Vladimir Mayakovski from 1927-1929. In their first edition, the authors explained the theoretical foundations of the writing in the journal, boldly stating that "LEF will agitate art with the ideas of the commune, opening the way for art in the future." As a loyal communist, Tret'iakov strongly believed that artists should not create art for art's sake, but rather attempt to raise the class consciousness of the readers and viewers. His goal was to create art that would be beneficial to the Soviet state and the goal of achieving communism in the Soviet Union.

By tracing a selection of his writings in LEF and Novyi LEF, I draw a connection between Tret'iakov's literary theory and theatrical aesthetics. In particular, I analyze the ways in which his plays Gas Masks and I Want a Baby! seek to minimize perceived space between the performers and audience in a way that involves audience members as participants instead of as traditional viewers. By redefining the relationship between artist and viewer, Tret'iakov created art that functioned as forum for critical conversation about problems in Soviet society

Humanities

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Diane Cline

ABSTRACT

E Pluribus Unum: Mystery Cults and Cognition in the Roman Middle Republic

On the instructions of the Sibylline Books, the Roman Senate imported to Rome the Phrygian cult of the goddess Cybele in 205-4 B.C.E. during the Second Punic (Hannibalic) War. Despite its foreign origins and radical ritual behavior, the Metroac cult would go on to become a pillar of Roman religion through the end of the Empire. This was especially remarkable given the fact that along the way, the popular Hellenic cult of the Bacchanalia was deemed unsuitable for society and extinguished by the Senate. Together, an examination of political circumstances at the time and a comparative cognitive analysis of both cults provide an explanation for why, despite similarities in ritual practice and symbolism, these two cults could have met such different fates.

Cognitive theory argues that humans perceive and organize the world through common structures of consciousness. These perceptions manifest in outwardly different languages, civilizations, and cultures that, when examined on a deeper level, hold fundamental similarities. First, I argue that the incorporation of the cult of Cybele was a symbolic gesture to establish an alliance with Phrygia during the Hannibalic War, and examine some of the methods employed by the Senate that helped integrate the foreign cult into Roman society. Then, I analyze both cults on a cognitive basis in terms of their myths and rituals, basing my methods on those used by Olympia Panagiotidou in her book, The Roman Mithras Cult: A Cognitive Approach. In doing so, I found that despite a surface-level difference in ritual performance, the underlying values of the Metroac cult were a renewal of traditional Roman ideas rather than a reformation. On the other hand, the values espoused by Bacchic rituals were contrary to Roman cultural ideals. These common values and other elements of practice that appealed to Roman citizens on a cognitive level allowed the foreign Metroac cult to flourish, showing that superficial differences do not necessarily reflect irreconcilable ways of thinking. This study has implications for the understanding of mystery cults and the lived experiences of their initiates, as well as for the study of diversity and religio-cultural diplomacy in ancient Rome. Finally, this study provides an example of how cognitive theory can be applied to historical analysis to recreate and better understand the lives, thoughts, and values of ancient peoples and societies.

Humanities

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ABSTRACT

Developing Humanistic Leaders

This paper attempts to answer the question, how might a leadership training program develop humanistic leaders? It examines the connection between leadership development and humanistic leadership because the author believes it is an underdeveloped subject, judging from the academic sources used in HOL 6100: Humanistic Leadership, which the author completed through The George Washington University in Spring 2019. The paper starts with an exploration of humanistic leadership's importance in our societal context. It moves on to explore human well-being, dignity, and the transformational potential of business before identifying the attributes of humanistic leaders. Finally, it concludes by examining how humanistic leaders can be developed through leadership training. The paper draws from traditional academic and business literature sources as well as more creative writings, like poetry. It draws from less conventional sources because the author holds the assumption that the creation of humanistic leaders is akin to a person's journey through self-awareness and toward self-actualization. Therefore, it is important to take into account logical, feelings-based, and spiritual perspectives to paint a whole person picture of a humanistic leadership development program.

Immuniology/Infectious Diseases

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ABSTRACT

Impact of Sexual Violence Exposure on Mucosal Cytokines and Anti-HIV Immune Biomarkers in Women

There is considerable overlap between the epidemics of violence against women and HIV/AIDS, both of which adversely and disproportionately affect women's health. Sexual violence is associated with increased risk of HIV acquisition/transmission in women, yet the immune-biological mechanisms linking the two are poorly understood. Specifically, it is unknown how genital tract regulation of these immune biomarkers associated with HIV infection and pathogenesis may be affected following sexual trauma. The objective of this study was to compare the levels of inflammatory cytokines/chemokines and protective/anti-inflammatory/HIV inhibitory factors, in the genital tract of women exposed to sexual violence, compared to those who have never been exposed. Recruitment for this longitudinal and cross-sectional study was performed in the District of Columbia metro area from 2014-2016 and consisted of women aged 18 and above. After administering informed consent, eligibility was determined using a brief survey, with Recent Cases being defined as women having experienced forced vaginal penetration during the preceding 12-weeks. Controls were defined as women who had never experienced forced vaginal penetration. Acute Cases were defined as women having experienced forced vaginal penetration during the past 4 days. Those eligible provided biological samples including ectocervical swabs for biomarker analysis. Protective/anti-inflammatory/HIV inhibitory biomarkers Serpin A1, Elafin, Secretory Leukocyte Protease Inhibitor (SLPI), and Human Beta-Defensin-2 (HBD2) were analyzed by ELISA. Inflammatory cytokines IL6, IL1, IL1, TNF, and chemokines MIP3, IL8, and IP10 were also analyzed similarly. One-way ANOVA and Kruskal-Wallis tests were used to determine differences between Recent Cases, Acute Cases, and Controls using GraphPad Prism. In Acute Cases, 4 days post event, we observed significant upregulation in levels of inflammatory cytokine/chemokines IL1, MIP3, IL8, as well as anti-inflammatory Serpin A1, Elafin and SLPI compared to Controls. Interestingly, inflammatory cytokine IL6 and chemokine IP10 were significantly downregulated in Acute Cases compared to Controls. None of these biomarkers were significantly different in Recent Cases (12 weeks post event), compared to Controls. Our data points to immune dysregulation in the female genital tract following exposure to sexual violence, which has the potential to increase HIV risk in this population.

Immuniology/Infectious Diseases

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RESEARCH MENTOR/DEPARTMENT CHAIR

Sidney Fu

ABSTRACT

Role of Differentially Expressed miRNAs in Lichen Sclerosus

Lichen sclerosus (LS) is a chronic, relapsing inflammatory dermatosis that presents with significant loss of the anatomical architecture and structural integrity of the anogenital skin. LS is characterized by patchy lesions and sclerotic plaques that can culminate in urinary and sexual dysfunction with increased risk of developing squamous cell carcinoma. LS is considered to be a rare disease and the true incidence of LS is unknown due to misdiagnosis given the wide range of dermal and morphological changes and underreporting. While the etiology of LS is unclear, there is mounting evidence that the pathogenesis of LS may involve immunogenetic autoimmunity. microRNAs (miRNAs), which are small, endogenous RNAs that regulate gene expression by binding to the 3' UTR of target mRNAs, may play a role in the development of LS. A recent study showed that aberrant expression of miR-155 induces loss of immune tolerance and promotes fibroblast proliferation. The objective of this study is to identify differentially expressed miRNAs in LS and to characterize the functional roles of these miRNAs in the development of LS.

With GW's IRB approval, 12 patients with a confirmed LS diagnosis were recruited. Skin tissue samples from LS-affected and their adjacent normal areas were biopsied and kept in RNAlater before total RNA isolation using the Trizol reagent followed by homogenization. Next-generation miRNA sequencing (miRNA-Seq) was performed and data was analyzed via GeneSpring and IPA bioinformatics tools. Real-time RT-PCR was performed to further analyze the expression of the most significantly altered miRNAs. miRNA-Seq analysis resulted in 171 significantly differentially expressed miRNAs, with 115 upregulated and 56 down-regulated ($p < 0.05$). If we use p value cutoff of < 0.01, there will be 85 differentially expressed miRNAs, with 55 -up and 30 -down regulated. The 85-miRNA clustered heatmap successfully separated LS from normal control. The IPA analysis resulted in a number of pathways, including those involved in autoimmunity involving miR-155 as reported earlier. Another miRNA, miR-675-3p is significantly downregulated in LS tissue compared to the normal adjacent tissue ($p < 0.01$ and fold change =2.47) confirmed by qRT-PCR. miR-675-3p is associated with susceptibility for diabetes mellitus, which is considered an autoimmune disease, and lung cancer. The differentially expressed miRNAs identified by miR-Seq would not only help explain the etiology of LS, but may also serve as biomarkers for LS diagnosis and intervention. miR-375-3p may be involved in LS autoimmunogenicity and may therefore be a potential target for LS therapy.

Immuniology/Infectious Diseases

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ABSTRACT

Analysis of Survivin Expression in Lymphocytes From Myasthenia Gravis Patients and The Relationship to Clinical Characteristics

Myasthenia gravis (MG) is an autoimmune disorder that targets the neuromuscular junction. Lymphocytes are involved in the development of autoreactive autoantibodies, with the majority of patients expressing antibodies against the postsynaptic nicotinic acetylcholine receptor (AChR). Survivin is a member of the inhibitor of apoptosis (IAP) family which we have found to be expressed by lymphocytes of patients with MG. Survivin is expressed on neoplastic cells and patients with various cancers have anti-survivin antibodies as well as T cells capable of recognizing survivin epitopes. We hypothesized that survivin expression in lymphocytes may be part of a mechanism of inhibits the apoptosis of autoreactive lymphocytes and would correlate with disease severity in MG.

The peripheral blood mononuclear cells (PBMCs) were obtained from MG patients and healthy controls (HCs) by using density gradient media (Ficoll). PBMCs were stained with anti-human CD45, CD4, CD20 plus extracellular or intracellular anti-Survivin. The extracellular or intracellular survivin expression of CD20+ lymphocytes were investigated from 29 MG patients and 15 healthy controls by using flow cytometry. We performed an extensive analysis of survivin expression and its relationship to disease severity, disease duration, treatment, thymic pathology, age and gender in MG patients and healthy controls. The data was analyzed for statistical significance using GraphPad Welch's t-test with $p < 0.05$ considered significant.

Survivin is primarily expressed intracellularly in CD4- CD20+ human B cells, and, CD4-CD20+ Survivin+ lymphocytes of MG patients are significantly higher than healthy controls. However, we found no significant correlation of survivin expression with clinical characteristics, although even among patients with long disease duration high levels of survivin expression were found regardless of clinical severity.

Survivin does appear to provide support for persistence of autoreactive cells in MG patients. The extracellular expression of survivin on the lymphocytes may represent an ability for inhibition of apoptosis to be transferred from one cell to another. Survivin does support persists of autoreactive cells. Its expression even in patients without clinical evidence of disease suggests these cells to be autoreactive but not pathogenic.

International Affairs

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ABSTRACT

Advancing Women as Agro-Leaders in Africa

African women are entering the agricultural industry at higher rates than any other region globally. According to the United Nations Food and Agriculture Organization (FAO), women have comprised 55-65% of the paid labor force in agriculture in sub-Saharan African (SSA) for the past decade. The World Bank shows that while women's contribution to African agricultural labor is 30% in some countries, it reaches as high as 80% in others. As the participation of women in agriculture in SSA continues to grow, women continue to be underrepresented.

SSA women are often expected to maintain their domestic responsibilities while participating in paid agricultural work. According to the FAO, women spend on average over 40% of their workday on unpaid domestic and care-related tasks causing longer working days than their male counterparts in similar positions. While this is a common daily hurdle hindering women from advancing into leadership roles, however larger more systematic economic, cultural, and financial obstacles are the primary deterrent.

To best explain these complex problems, implications, and resolutions I will examine four African countries, Mali, Ghana, Kenya, and Malawi. These countries provide diverse agricultural environments, cultural backgrounds, economic landscapes, and political obstacles that have caused governments, communities, leaders, and organizations to take look at different methods to advancing women in agriculture.

Based on the FAO's State of Food and Agriculture 2010-2011 reporting on women in agriculture internationally, these roles are defined as an African woman's participation in organizations, associations, cooperatives, governments, unions, or any entity that may positively influence African women's rights, access, social empowerment, and legal or political representation concerning farming and agriculture. Women seen in leadership roles led to greater trust in agriculture institutions and serve as role models for the girls of future generations. Women in leadership also targeted other women specifically to support their agricultural practice. When women are able to circumvent the policy or culture barriers that prevent them from accessing necessary resources, women were able to earn a better income for their households. Findings demonstrate that when women farmers in Mali, Ghana, Kenya, and Malawi are empowered in agriculture through necessary tools and allowed access to obtain leadership roles, the economic benefits span beyond the individual or household and into the community and beyond.

International Affairs

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ABSTRACT

Climate Change and African Migration in the Southern Cone of South America

Over the past decade, the number of African immigrants in South America has increased drastically. Argentina, Brazil, and Chile have a large percentage of African immigrants specifically from Senegal, Nigeria, and Ghana. Furthermore, in an age where populations are experiencing the rapid effects of climate change, how does this affect communities in West Africa? The African Union is aware of how climate change is affecting the African countries and is working towards finding solutions through its commitment to the United Nations Sustainable Development Goals, but is that enough? This paper observes and analyzes how and to what extent climate change plays a role in migration patterns from West Africa to the South American Southern Cone and what this looks like for the sustainable development of the receiving and origin countries. This paper will be a comparative case study between the West African origin countries and the South American receiving countries. Additionally, it will evaluate the push and pull factors for West African migrants that migrate to Argentina, Brazil, and Chile and if the effect of climate change has played a significant role in their decision. Furthermore, I will analyze the economic impact African immigrants have on the South American countries and how the migrants contribute to the sustainable development of their origin countries through opportunities and labor in the receiving country. This paper achieves this by analyzing observations made in existing literature, interviews, and media. There exist very few scholarly articles or research specifically dedicated to climate change-induced West African migration to South America. Thus, this research will help expand knowledge on West African migration to Brazil, Argentina, and Chile as well as fill the education gap discussing how African migration affects the sustainable development of their receiving and origin countries.

International Affairs

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Matthew Kirwin

ABSTRACT

Public Opinion Analysis and the Anglophone Crisis in Cameroon

The two Anglophone Regions of Cameroon have been impacted by a war of secession since the beginning of 2018 that has seen hundreds of thousands displaced, and thousands killed. The conflict has its historical origins in the aftermath of the First World War that saw the colony of German Kamerun divided between the British and the French who governed the respective territories under their own colonial systems. Following the Second World War, and the commencement of decolonization processes across sub-Saharan Africa, the United Nations General Assembly passed a resolution in 1961 that stated the two British Colonies, Northern Cameroons and Southern Cameroons, would hold plebiscites to determine if the two territories would join Nigeria or Cameroon. British Northern Cameroon chose to incorporate into Nigeria, whereas British Southern Cameroons chose to "reunite" with the newly independent Republic of Cameroon which had previously been a French colony. This led to British Southern Cameroons formally becoming part of the Republic of Cameroon in 1961, under a federal system of governance.

In 1972 the first Cameroonian President, Ahmadou Ahidjo eliminated the federal system of governance and began limiting the autonomy of the Anglophone regions of the country. Following Cameroon's return to multi-party democracy during the early 1990s, Anglophone Cameroonians began to express their desire for more autonomy. This led to the All Anglophone Conferences that occurred in 1993 and 1994, that first demanded a return to federation and subsequently for independence. This sentiment eventually died down as many of the independence activists who emerged during the 1990s departed Cameroon. A rise of Anglophone sentiment first for federation, and then for independence emerged in 2017 after the government violently oppressed demonstrations by educational and legal professionals. However, this emergence of Anglophone nationalism led to an outbreak in conflict in which armed groups have militarily fought the Cameroonian army.

In this paper, public opinion is examined both during, and the years leading up to the Anglophone Crisis to gain an understanding of why the conflict turned violent in 2017-18. This public opinion examined is the result of surveys carried out by the U.S. Government that have subsequently been declassified. In responses of Anglophone Cameroonians are quantitatively examined in order to determine what particular grievances were held by the population. This is then compared with empirical analysis to examine correlations between events on the ground and public sentiment to determine its impact on the conflict.

International Affairs

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ABSTRACT

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International Affairs

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ABSTRACT

U.S. Security Policy Decisions and the Impact of Domestic Politics on International Choices: A Case Study of Security Policy Toward Haiti 1990-1995

About three years following the 1991 Haitian coup d'état, which overthrew democratically elected President Jean-Bertrand Artiside and instated a military junta led by General Raoul Cédras, U.S. President Bill called upon the military to force Cédras to step down and return Artiside to power. This paper seeks to answer the question, "Why did the U.S. shift its security policy toward Haiti, January 1, 1990 through December 31, 1995?" Furthermore, it provides a detailed chronology of domestic politics and security policy toward Haiti during this time, highlighting a key policy turn: from cooperating in the 'successful' negotiation of the Governor's Island Agreement in July 1993 to the decision to use military force in Haiti to guarantee regime change in September 1994. Within this decision, issues such as the intersection of immigration, race, domestic politics and foreign policy will be discussed.

Traditional neorealist international relations theory by Kenneth Waltz dictates that the international system exists in anarchy, and the main structure of this system is the distribution of political, military, and economic power. According to this theory, the U.S. should have used their superior military, political, and economic power to ensure that Haiti was governed by the person of their choice in 1990. However, history shows that the U.S. waited three years before forcing change, in what was eventually an inadequate show of military force. Waltz's theory fails to explain this timeline. This paper will analyze this incoherence and look to other theories such as William B. Quandt's theory about domestic government structure, process, and elections and Jeffrey Kimball's theory of factionalism and their impact on foreign policy choices. This paper looks at evidence from the system, state and individual levels of analysis to look at the security policy decisions of the H.W. Bush and Clinton Administration toward Haiti, highlighting the role that domestic politics and debates can have on international security policy.

International Affairs

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Lori Gronich

ABSTRACT

Sunset over Lahore: The Intelligence Community on the Kargil War

Between January 1st, 1995, and December 31st, 1999, the relationship between Pakistan and India changed fundamentally as a result of a wide range of security concerns on the individual, state, and system levels. The Kargil war, its power games, and politics, provided a dramatic turn in a relationship that seemed to be progressing towards detente after the events of the Lahore conference and its subsequent declaration. To this day it is unknown who was responsible for its initiation, with all parties responsible in Pakistan continuing to deny their own responsibility for Pakistan's worst failure since 1971. The goal of this project is to provide a clear illustration of the policy, power and decision making occurring in Pakistan during the events leading up to the Kargil War, and the actual information surrounding the military operation. Utilizing the information from the intelligence community, and the scholarship produced through international effort, this paper will delve into the murky details surrounding a conflict that continues to shape world affairs to this day. Through discussing this pivotal moment in history, it becomes clear how two countries with deeply intertwined histories came so close to peace before devolving towards the edge of nuclear war.

International Affairs

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Ned Lazarus

ABSTRACT

MEETing at the Intersection of Peacebuilding and Military Service

This paper analyzes how peacebuilding organizations in Israel/Palestine confront the issue of mandatory military service among Israelis. To answer this question, I interviewed ten alumni from MEET (Middle East Entrepreneurs of Tomorrow), as well as other experts in the field. I then analyzed and coded all interviews and compared it to other research done at Seeds of Peace. My results show that that MEET is still learning and changing how it talks about military service. While most alumni feel that the discussion is not perfect, they see MEET moving in a positive direction. Additionally, many MEET alumni reported that MEET helped them become better and more empathetic leaders when they joined the army. Also, most Israelis and Palestinians agree that MEET should not advocate for refusal to serve in the military. Finally, the interviews show that Palestinians understand the cultural importance of military service for Israelis. For organizations like MEET and Seeds of Peace, the question of army service is one that remains a challenge; this research paper hopes to be a tool for peacebuilding organizations to better understand and address the topic at hand.

International Affairs

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ABSTRACT

Lipstick Martyrs: How Media Portrayals of Female Terrorists Play a Role in the Radicalization of Vulnerable Girls

Female terrorists fascinate Western media. Several studies prove that vast differences exist in the portrayal of female operatives versus their male counterparts. Caricatural portrayals of female operatives often mirror traditional tabloid language of beauty, body, and boyfriends, and like many female celebrities, little coverage is dedicated to their actual deeds and capabilities. Extensive psychological and sociological research has already explored the effect this kind of sexist rhetoric can have on girls and their identity formation. The question remains, if media portrayal of female terrorists uses similar rhetoric to media portrayals of other famous women, could it have a similar influence on young girls' perceptions of womanhood?

Using current research on the way young girls interact with figures in popular media, this paper breaks down the process of exposure, attachment, and influence, and analyzes potential consequences if the process is applied to female terrorists. Research findings show that while there is not a direct causal relation between radicalization and the romanticization of female operatives in the media, such media coverage can lead to the formation of harmful ideologies about love, beauty, and gender roles, which can make young girls more vulnerable to traditional recruiting tactics. After identifying specific practices as contributing to the overall phenomena, this research offers recommendations on how to disseminate information about female terrorists in a manner that deters future potential actors.

International Affairs

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ABSTRACT

To Stop Iran, Return to the Negotiation Table

The US-Iran conflict has witnessed some dramatic changes and reached its climax after President Donald Trump took office in early 2017. In mid-2018, he decided to withdraw from Iran's nuclear deal, which was signed by his predecessor, Barack Obama, and also retightened the slightly relaxed economic and financial sanctions that have been imposed on Iran since 1979. As a prelude to an actual military confrontation, in May 2019, as an implied message to warn the Iranian regime that military action is not excluded, the United States sent an aircraft carrier and a bomber task force to the region.

Iran's military responses, however, exceeded all expectations. The military capability that Iran has shown, to thwart the US' threats and intimidations, was far greater than the one a state after four decades of harsh economic and financial sanctions could possess. In July 2019, Iran shot down a $200 million US drone that was hovering over the strait of Hormuz. In November of the same year, Iran, through his proxies in Yemen, launched a series of drone and missile attacks on the world's largest oil finery fields in Saudi Arabia, the US' closest ally in the region. In January 2020, Iran rained a US military installation in Iraq with dozens of locally-made or improved mid-range ballistic missiles. It is evident that the US coercion policy, economic and financial sanctions, and/or a patient strategy of attrition, in the past four decades, have not only proven to be futile but also helped the theocratic regime to build a military power that is capable to challenge the US supremacy, gain control over militias and terrorist groups in the area to mobilize them against the US interests at a time needed, and build a greater capacity to exercise power in the neighboring countries (Iraq, Syria, Yemen, and Lebanon).

In the following essay, I present choices available for the United States to deal with Iran's threat and argue that the ideal foreign policy prescription to stop Iran, change its behavior, and attain favorable political objectives, is to revamp the nuclear deal and integrate Iran with the international order.

International Affairs

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Neal Kringel

ABSTRACT

United States of America Whole of Government Approach in Fragile States: Libya and Iraq

Whole of Government Approach (WGA) encompasses unification of government departments responsible for security, political and economic affairs including development aid and humanitarian assistance. Fragile states need WGA to minimize state weakness and promote socio-economic development. Alignment of WGA with states' interests while minimizing risk associated with conflict is necessary for policy makers to consider because the United States need to maintain international influence and unification. However, as evidenced in the United States interventions in Libya and Iraq, WGA is not coherent in practice.

Segments of WGA pursue their own departments' policy objectives without aligning themselves with larger US interests, such as Department of State and Department of Defense. This ultimately undermines post-conflict resolution efforts. This study evaluates military interventions conducted during the George W. Bush, Barack Obama administrations, and Trump's "America First" philosophy. By using the Organization for Economic Co-operation and Development's (OECD) ten good international engagements, which were analyzed using the categories of human rights, state-building and cooperation.

In the George W. Bush Administration and Obama Administration, Iraq and Libya respectively provide a good case to test WGA because Iraq did not receive United Nations Security Council authorization while Libya did. The George W. Bush administration and the Obama administration have some similarities, the Trump administration is unilateral. This study relies on evidence drawn from primary sources and secondary sources to demonstrate how agency rivalry affects WGA.

Findings from this study show that internal conflicts between US federal departments and agencies impede a successful WGA. Moreover, the US struggles to undertake long-term sustainability programs in fragile states. Drawing on the findings of this study, it is recommended that the United Nations permanent members must be reviewed to achieve accountability. As for the US, fragile states fall under countering the priorities of violent terrorism and democratic societies. Policy recommendations are offered for conflict prevention to promote human rights, state-building and cooperation among nations.

International Affairs

Elliott School of International Affairs

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Sunhye Kim

ABSTRACT

Juche Ideology and the Legitimization of the Kim Regime

This essay will explain how Juche ideology legitimizes the Kim regime and will take a deep look into how Kim Jong Un's legitimacy in relation to Juche compares to that of his predecessors and how it explains the young leader's decisions. The Kim family is ingenious in their usage of Juche as a means of demanding devotion to the state. Elements of Juche, particularly cult of personality, nationalism (bordering on xenophobia), comprehensive solution and purges collectively create a convincing narrative to the North Korea people that in order to be protected by the outside world, they must place their faith in the Kim family. This paper will first define Juche and compare it to the ideologies that have inspired it: Marxism, Stalinism and Maoism. Then an exploration of the history of Juche and how Kim Il Sung used it to gain and maintain power will be discussed followed by an examination of each of the three Kim's versions of Juche. Finally the paper will analyze Kim Jong Un's inherent legitimacy as compared to that of his father and grandfather and how it relates to Juche and what it means for future relations with the hermit kingdom.

International Affairs

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ABSTRACT

Domestic and International Media Representation of Indonesia's 1998 Mass Violence

Suharto's Indonesia was defined by a series of cultural propaganda purposed to isolate and suppress foreign cultures, most notably Chinese influences. The New Order regime upheld oppressive laws that perversely impacted Chinese-Indonesians and women. The regime's eventual demise is characterized by a series of social and economic crises, most notably the 1998 riots and amidst it; the mass rapes. This paper examines the ways in which media laws under Suharto's Guided Democracy and restricted regime reported the 1998 mass rapes, alongside the domestic and international political implications of said reporting. The paper makes several observations primarily from publications in the months of May, June, and July of 1998. In addition, this paper also proceeds to observe foreign reporting, especially from China and the US. The language utilized by media outlets in referencing Chinese-Indonesian citizens and women are all reflective of broader and more intricate issues that are so entrenched in Indonesian culture and social structures. These social structures further define Indonesia's global standing.

International Affairs

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Sunhye Kim

ABSTRACT

Human Trafficking and its Subjugation of the Female Population in Korea

In 2018, the U.S. State Department's Office to Monitor and Combat Trafficking in Persons placed South Korea as a Tier 1 country in their standards of eliminating the trafficking of individuals and forced labor. While the ROK stands at Tier 1, the recent 2019 Trafficking in Persons Report: Republic of Korea published in June 2019 outlines that the laws in place are satisfactory, but the action taken by law enforcement to implement these laws suffer. This research paper aims to give reasoning as to why human trafficking continues to be ever-present in South Korean society, despite the strict countermeasures that the South Korean government boasts. This paper will go beyond the loopholes in the justice system, instead looking at the motivators in Korean society that perpetuate the crime. These factors include the socioeconomic structure of a modern Korea, and cultural factors that lead many to turn a blind eye to human trafficking.

International Affairs

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ABSTRACT

"Revolution, Regimes, and War": Iranian Security Policy Towards Iraq, 1978-1988

American policymakers today are divided about what to do about Iran. While the Obama Administration engaged in negotiations with Iran over the JCPOA, some policymakers, such as former National Security Advisor John Bolton, have gone so far as to advocate for pursuing regime change in the Islamic Republic. Currently, the United States continues to impose crippling economic sanctions. As tensions continue to rise, a consensus over policy towards Iran has yet to emerge. Crucial to forming affective policy towards Iran is understanding the sources of Iranian conduct.

This paper will consider what factors make Iran more cooperative in its foreign policy. By investigating shifts in Iran's foreign policy towards Iraq, United States policymakers can be better informed on Iranian decision-making. To better understand the causes of Iran's foreign policy decisions, this paper will ask: Why was Iran's foreign policy towards Iraq sometimes more cooperative and sometimes less cooperative between January 1, 1978 - December 31, 1988? This time period includes the Iranian Revolution and the subsequent Iran-Iraq War, the largest conventional war of the 20th century.

This paper will assess how Iran chooses policy actions of more and less cooperation when under stress, internationally as well as domestically. To do this, I develop a comprehensive historical chronology, drawing on information from the system level balance of power, state level politics, and individual decision makers in Iran. With this knowledge in hand, I will use the findings of this research to show to policymakers today what Iran does when facing certain kinds of pressure. When equipped with this information, US policymakers may be more affective at inducing cooperation from Iran in the future.

International Affairs

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Shirley Graham

ABSTRACT

Experiencing Combat Before Childhood: ISIS' Use of Child Soldiers and the Legal Role of the International Community

As ISIS loses its stronghold in Syria and Iraq, the issue of what to do with captured ISIS fighters moves to the forefront of international concern. Particularly, many policymakers and human rights advocates are debating how to treat ISIS child soldiers. The crux of the debate centers on the culpability and ongoing security threat of ISIS child soldiers and the ability, if it exists, to reintegrate these children back into society. This conversation is especially relevant as there are unprecedented numbers of non-Syrian and Iraqi foreign child soldiers involved in the conflict. Therefore, the international community must approach the issue differently than it has in past cases of child soldiers. This paper will analyze, through international legal frameworks, existing literature and released ISIS documents to determine the recruitment, experiences, and reintegration possibilities of three types of ISIS child soldiers: foreign children, local children, and orphaned children. Through the detailed examination of each group, the conclusion emerges that these children have experienced and perpetuated both violence and trauma, which will undoubtedly impact their ability to function in society. The application of The Convention on the Rights of the Child, The Optional Protocol on Armed Conflict, The Convention on the Elimination of all forms of Discrimination Against Women, and The Women Peace and Security Resolutions of 2467 and 1325 makes evident that stakeholders must take immediate steps to de-radicalize and reintegrate all children, regardless of their nationality. Reintegration and de-radicalization of children is necessary not only from a legal perspective but also from the perspective of peacebuilding and overall national security. Action by the global community is necessary in order to prevent the revictimization of former ISIS child soldiers and the reemergence of the terrorist organization.

Natural Sciences and Mathematics

Columbian College of Arts and Sciences

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Andrei Afanasev

ABSTRACT

Absorption of Topological Light by Quantum-Entangled Ions

Cold trapped ions have been used for decades in spectroscopy and tests of quantum systems. More recently, experiments involving quantum state engineering have studied the interaction of light with trapped ions for quantum computing applications. Topologically structured light, or an optical vortex, carries orbital angular momentum and can probabilistically excite an atom. For two ions localized near an optical vortex, the probability of excitation exhibits spatial dependence. For example, for certain values of angular momentum, if the axis of the beam coincides with the midpoint between the two ions, then the absorption probability is zero. This is an effect of quantum coherence for entangled particles. In order to study this topological effect, the angular momentum carried by the beam was varied, as was the location of the beam axis relative to the two ions. Calculations are based on light at a wavelength of 729 nm interacting with two Calcium-40 ions whose wave functions overlap completely.

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Keith Crandall

ABSTRACT

DNA Barcoding of Prospective New Arkansas Crayfish Species

Crayfish are an important ecological resource in freshwater systems, and understanding their taxonomic relationships is important for species delineation and conservation. We present a DNA barcode analysis of more than 151 crayfish specimens spanning over 20 species to contribute to the determination of a potential new crayfish species from the state of Arkansas in the United States. We use maximum-likelihood and Bayesian methods to present a phylogenetic analysis of mitochondrial DNA to represent possible evolutionary relationships between the proposed new species and other crayfish species found in Arkansas. Mitochondrial cytochrome-oxidase subunit I (mtCOI) and nuclear 16S ribosomal RNA (16S) regions of the genome were amplified for 30 unknown subjects; samples were then sequenced, aligned, and assembled alongside mtCOI and 16S sequences of known Arkansas crayfish species cataloged in GenBank. The phylogenetic tree derived mtCO indicates a close relationship with the genus Cambarellus, while the 16S data suggest a closer relationship between the unknown specimens and the genus Procambarus. Further testing with more genes may help to resolve the relationship of the proposed new species.

Natural Sciences and Mathematics

Columbian College of Arts and Sciences

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Józef Przytycki

ABSTRACT

A Counterexample to Marché's Generalization of Witten's Conjecture

Edward Witten had conjectured that the Kauffman bracket skein module over the field of rational functions of a closed oriented 3-manifold is finitely generated. In 2019, Julien Marché formulated a generalization Witten's finiteness conjecture for skein modules over the ring of Laurent polynomials in an invertible element. In this poster, I will present a counterexample to this conjecture, which I recently found. The counterexample is based on Maciej Mroczkowski's work on the Kauffman bracket skein module of the connected sum of two copies of the projective space.

Natural Sciences and Mathematics

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RESEARCH MENTOR/DEPARTMENT CHAIR

Cynthia Dowd

ABSTRACT

Design And Synthesis Of Fosmidomycin Analogues As Dxr Inhibitors To Combat Malaria And Tuberculosis

Tuberculosis and malaria are caused by the pathogens Mycobacterium tuberculosis (Mtb) and Plasmodium falciparum (Pf), respectively, and are two of the world's deadliest infectious diseases. As such, their complicated life cycles and the emergence of drug resistant strains highlight the necessity for novel treatments. Many modern antibiotics primarily target metabolic enzymes, on which Mtb and Pf rely heavily to synthesize important secondary metabolites. Deoxy-D-xylulose-5-phosphate reductoisomerase (Dxr), a critical enzyme in isoprenoid biosynthesis, is one such protein. Its importance in the methyl erythritol phosphate (MEP) pathway and presence in Mtb and Pf but not in humans highlight Dxr as a promising inhibition target. The retrohydroxamic acid natural products fosmidomycin and FR900098 inhibit Dxr but exhibit poor pharmacokinetic properties and face challenges in cell permeability. Based on these natural products' structures and those of prior inhibitors from our lab, we have designed and synthesized a series of small molecule fosmidomycin analogs with a variety of N-acyl substituents. Achieving considerable in vitro potency against Pf and respectable Dxr binding affinity, we present the synthesis and early biological evaluation of these compounds as therapeutic agents for malaria and tuberculosis.

Natural Sciences and Mathematics

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ABSTRACT

Design And Synthesis Of Fosmidomycin Analogues As Dxr Inhibitors To Combat Malaria And Tuberculosis

Tuberculosis and malaria are caused by the pathogens Mycobacterium tuberculosis (Mtb) and Plasmodium falciparum (Pf), respectively, and are two of the world's deadliest infectious diseases. As such, their complicated life cycles and the emergence of drug resistant strains highlight the necessity for novel treatments. Many modern antibiotics primarily target metabolic enzymes, on which Mtb and Pf rely heavily to synthesize important secondary metabolites. Deoxy-D-xylulose-5-phosphate reductoisomerase (Dxr), a critical enzyme in isoprenoid biosynthesis, is one such protein. Its importance in the methyl erythritol phosphate (MEP) pathway and presence in Mtb and Pf but not in humans highlight Dxr as a promising inhibition target. The retrohydroxamic acid natural products fosmidomycin and FR900098 inhibit Dxr but exhibit poor pharmacokinetic properties and face challenges in cell permeability. Based on these natural products' structures and those of prior inhibitors from our lab, we have designed and synthesized a series of small molecule fosmidomycin analogs with a variety of N-acyl substituents. Achieving considerable in vitro potency against Pf and respectable Dxr binding affinity, we present the synthesis and early biological evaluation of these compounds as therapeutic agents for malaria and tuberculosis.

Natural Sciences and Mathematics

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Richard Tollo

ABSTRACT

The Katsuk-Talapus Composite Edifice: Using a Pleistocene-Age Mafic Eruptive System to assess modern hazards in the Three Sisters Area of the Cascades Arc, Oregon

The Cascades arc in Oregon is dominated by mafic Quaternary-age volcanics produced by nearby subduction. Whereas more-recent Holocene eruptives locally overlie many Pleistocene-age products, it is pertinent to develop a framework for the underlying volcanics to adequately evaluate local magmatism. Employing the Principle of Uniformitarianism in reverse suggests that deciphering both Holocene and Pleistocene magmatic processes are key to both predicting and minimizing hazards from future eruptions. Utilizing field investigations and petrographic techniques, this project utilizes the Katsuk-Talapus composite edifice as representatives of Pleistocene-age mafic eruptive mechanisms in the Three Sisters area of the Oregon Cascades. Penecontemporaneous eruptions ocurring along a 1 km-long fissure, producing a pair of closely spaced mafic scoria cones joined by a conical depression, both basalt to basaltic andesite in composition. The rim of Talapus cone is composed of oxidized agglutinate deposits, bombs, and non-oxidized, fine-to-moderately vesicular blocks displaying quenched margins indicative of rapid quenching during ballistic transport and extensive post-depositional degassing. Oxidized bombs and tephra erupted from Katsuk cone. The central crater contains interfingering lobes of olivine-bearing lava flows exhibiting upward-coarsening vesicles and brecciated flow tops. Columnar jointing along the northeast wall of the crater indicates subaerial cooling and contraction. Large gas cavities located at contacts of the flows, which formed during extensive degassing, indicative of interactions between ice and water during cooling. These observations indicate that the edifices erupted in locally effervescent styles involving volatile-rich lavas, that formed both lava flows and tephra, which was likely erupted from the uppermost parts of an evolving magma reservoir. Such eruptions likely produced far-travelled tephra and noxious sulfuric gas which, if erupted today, would close nearby roads and recreation areas while polluting the air and nearby supplies of drinking water. Because the western flank of nearby South Sister volcano is expanding in response to abnormal heat flux, it is critical to anticipate future activity in the area. Correspondingly seismometers and GPS stations are employed to monitor deformation at South Sister but are absent at these mafic edifices. Considering the eruption history at Katsuk and Talapus, and ongoing ominous observations at South Sister, it is critical to monitor for signs leading to eruptions. Considering the past violent behavior at Talapus and Katsuk, it is imperative to learn from the past in assessing modern threats.

Natural Sciences and Mathematics

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Alexander van der Horst

ABSTRACT

Computing High-Redshift Gamma Ray Bursts for SCORPIO

SCORPIO is an imager and spectrograph capable of simultaneously observing eight bands at once, and should be operational at the Gemini Observatory by 2022. SCORPIO will vastly improve our capacity for data collection in the optical and near-infrared. Due to its uniqueness, astronomers are exploring what SCORPIO's scientific output will look like, and how accurate it will be. Through SCORPIO, researchers will be able to better understand GRBs, including their mechanisms and host galaxies. GRBs are thus effective probes of the farthest reaches of the Universe, and provide valuable information about both the Universe's composition and data from its infancy; as such, this report will aid in the discovery of new knowledge in science's search to understand it. This research aims to better prepare us for SCORPIO's debut, both by looking at historical data for high-redshift gamma-ray bursts and by simulating bursts at high redshifts. Examining these, the authors develop a code for quick redshift computation from SCORPIO imaging data. Results indicate that SCORPIO will be very effective in photometric redshift determinations via models.

Natural Sciences and Mathematics

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Sylvain Guiriec

ABSTRACT

Audio Instrument Isolation via De-Noising Auto Encoder

This research project is centered on developing software that can isolate individual instrument signals called "stems" from a commercial level multi-instrument audio file (.wav, .mp3) through machine learning techniques. For example, using the song Superstition by Stevie Wonder in this software, one could choose to pull out only the drum signal, thus isolating the drum "stem" from the entire song in order to place it in its own audio file. This process involves heavy data manipulation techniques from signal processing, as well as an Auto-Encoder machine learning neural architecture to effectively isolate individual instrument stems. Traditionally, Auto-Encoders are used for data compression. When the input and output are identical, the Auto-Encoder learns to "encode" the data into a reduced form and to decode the reduced form back into its original dimensions. In this project, the Auto-Encoder architecture is given a full multi-instrument track as the input and an isolated instrument track as the output. This configuration trains the Auto-Encoder to treat all other instruments as "noise" in order to isolate a single instrument signal. Currently, the training data used in this project is focused on isolating drum stems from Hip Hop/R&B/Pop Rock songs produced within the last thirty years. The project scope will be expanded to many more genres and instruments once the current area is perfected. This research will have a significant impact on the music community in regard to "sampling" techniques, and it successfully demonstrates the De-Noising capabilities of Auto-Encoder neural architectures that can be applied to the field of signal processing.

Natural Sciences and Mathematics

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Christopher Cahill

ABSTRACT

Modulation of Electronic Properties of a Uranyl-Lead Structure Probed via Structural and Spectroscopic Methods

Understanding the electronic structure and properties of uranium containing materials has broad reaching implications from disposition of nuclear waste and nuclear forensics. A forum for establishing structure-property relationships is via probing how the luminescence behavior of a material is affected by the presence of secondary metals centers. Modulation of uranyl (UO_2^{2+}) luminescence in particular by post-transition metals, however, is poorly understood, owing to the fact that there are less than one hundred such compounds reported, with only 29 containing lead. The lack of available structures highlights the need to expand this family of materials in an effort to explore the fundamental chemical properties and bonding relationship of such materials in the solid state. We are attempting to address this issue by synthesizing a series of uranyl-lead materials via hydrothermal synthesis. Our efforts thus far have yielded yellow crystals of heterometallic $[UO_2Pb(DG)_2]$ (DG = diglycolic acid) which were structurally and electronically characterized by single crystal X-ray diffraction and temperature- and time-dependent luminescence. These compounds consist of a uranyl and lead center linked via bridging diglycolic acid ligands. Luminescence measurements reveal enhanced uranyl emission at low temperatures. The analogous homometallic complex, $[UO_2(DG)_2]$ curiously does not display this behavior, retaining a dull emission at both room and low temperature. Lifetime measurements point to divergence of radiative electronic pathways for uranyl in the presence or absence of lead. This phenomenon is unreported within the known mixed uranyl-lead hybrid compounds. As such we look to explore this behavior by expanding the available structures within a first-principles study. The aim is to develop and enhance the understanding of fundamental properties and bonding of uranyl hybrid materials.

Natural Sciences and Mathematics

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ABSTRACT

High Resolution Microscopy Analysis of Amylin Turnover in Pancreatic Beta Cells

Human islet amyloid polypeptide (hIAPP) is a molecule cosecreted with insulin from pancreatic β cells which plays a complex role in glucose regulation. In patients with Type Two Diabetes Mellitus (TTDM), human amylin can form toxic protein aggregates, leading to a loss of pancreatic beta-cell mass. The complete mechanism by which hIAPP is trafficked through and becomes toxic to cells has yet to be elucidated. Because hIAPP is a hormone, it should be processed through the cell's biosynthetic compartments, endoplasmic reticulum and golgi apparatus, before being excreted into the blood. However, transmission electron and confocal microscopy studies of rat insulinoma (INS) cells which express human amylin show that it may also be directed to other intracellular organelles, such as the mitochondria and the nucleus. To investigate the impact of human amylin in the mitochondria, we ran an MTT viability and metabolic assay. We found that overexpression and intracellular accumulation of hIAPP sensitizes these cells to ER stress evoked by thapsigargin, thus providing a regulatory link between ER stress and hIAPP evoked mitotoxicity. To further investigate amylin nuclear trafficking, we treated human pancreatic islet cells with thapsigargin, tunicamycin (both ER stress inducers) and high glucose conditions, and tracked the location of hIAPP using 3D confocal microscopy. We found that non-aggregated hIAPP accumulated in the nucleus and the nucleolus of cells. In future studies, we hope to elucidate the specific mechanism by which amylin translocates to the nucleus/nucleolus of cells, and investigate any toxic affect or functional role it has in these compartments. Elucidating amylin's mechanisms of trafficking and toxicity could lead to novel therapeutic interventions for patients with TTDM, as well as a greater understanding of how cells manage toxicity induced by misfolded proteins.

Natural Sciences and Mathematics

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ABSTRACT

Immersed Finite Element Methods for Interface Problems with Multi-Domains and Triple-Junction Points

Partial differential equation (PDE) plays an important role in simulating natural phenomenons such as water flow, air flow, stress on materials and pollutant transportation. In science and engineering, we are often forced to simulate on domain consisting of multiple materials which are separated by curves. This is so called `interface problem'. Elliptic interface problem is a particular class of interface problem which has received wide attention in the past decades. Numerous numerical methods have been developed to generate accurate and effective approximations for interface problems.

In this project, we introduce a class of immersed finite element (IFE) methods for elliptic interface problems with multiple domains and triple-junction points. Our methods do not require the mesh to fit the interface, therefore structured triangular meshes or Cartesian meshes can be used. On interface elements involving more than one interfaces or with a triple junction point, we construct new IFE basis functions. To handle the non-homogeneous flux jump, we enrich the local approximation spaces by adding up to three flux basis functions. Our numerical results indicate that the interpolation and numerical solutions possess the optimal convergence rates in both L2 and semi-H1 norms for multi-domain interface problems. This work is collaborated with Songming Hou and Xu Zhang.

Natural Sciences and Mathematics

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ABSTRACT

Silent Builders: Termite Mounds in Queensland, Australia

Ecosystem engineers have a significant impact on their environment. For example, beavers, leaf rollers, and desert isopods all change their environments in a visible way that has an impact on their ecosystems. An important example of ecosystem engineers are termites, which affect their environment by breaking down wood, building mounds, and changing soil properties. As termites have a clear effect on wood decay in tropical systems, their species composition and abundance on the landscape have important implications for biogeochemical cycling.Termite species turnover may be highly correlated with precipitation gradients, as precipitation rates in an environment often determine community assembly in Northern Queensland. However, the impacts of termites on soil chemistry, and the major environmental variables affecting their species turnover, is not well understood. In this study, we collected mound samples from three different sites in Northern Queensland, Australia, and measured carbon and nitrogen content, height, diameter, edge thickness, hardness, density, and water mass loss of each mound. We found much lower levels of carbon and nitrogen content in mound samples from savanna sites compared to rainforest sites, likely because the termites in the rainforest use more organic building materials. Understanding the effects that termites, and in turn their mound composition, have on soil chemistry could provide understanding of soil dynamics as a whole, and could have important implications for soil science, as termite mounds are often neglected in this field.

Natural Sciences and Mathematics

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ABSTRACT

The Gut Microbiome of Northern Australian Termites

As some of the world's most effective decomposers, termites and their gut microbial symbionts can break down wood, grass, litter, soil, and other complex compounds. However, when most people think of termites, they think only of the pest species that break down wood in human homes, which comprise only 1/30 of termite diversity. Of the abundance of termite gut microbiome research looking at the relationship between these termites, their symbionts and decomposition, the majority have focused on the microbial communities of a few pest species and ignored the wealth of information that can be gleaned by looking at the gut microbiome of other termite guilds such as grass-feeders and litter-feeders. Additionally, to date, most termite gut microbiome studies have used 16S amplicon method, which economically reveals the bacterial species present in a community, but overlooks any eukaryotic organisms present in a sample, and sometimes presents bias. In this study, we compare the 16S amplicon method with its counterpart whole metagenomic shotgun (WMS) sequencing, which allows us to take a snapshot of all microbes present in termite guts from different feeding guilds. We contrast the alpha, beta and gamma diversity portrayed by these two methods and evaluate two common microbial DNA extraction kits commonly used for termite gut microbiome studies. We analyze the community differences in two grass-feeding and two wood-feeding species of termites and highlight key similarities and differences in taxa between the two guilds. With the advances in microbiome analysis techniques, it is important to gain an understanding of the bias that comes attached to each method, and this project is key to realizing what is missing or overabundant in these types of studies.

Natural Sciences and Mathematics

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ABSTRACT

A Viability Study of the Use of δ15N in Submerged Tissue to Calculate a Postmortem Submersion Interval: A Potential New Tool for Forensic Aquatic Recovery

Stable isotopes have become a vital analysis technique for the field of forensic science. Stable isotopes contain a stable nucleus that does not decay over time like radioactive isotopes and therefore aid in the detailed reconstruction of biological processes. Ratios of stable isotopes are useful models for exploring the geographic origins, diet, and travel history of unknown human and animal remains. The isotopic profile of nitrogen ($\delta^{15}N$), specifically, aids in the reconstruction of protein consumption and dietary preference. This project will utilize the signature of $\delta^{15}N$ in a different way than typically applied, looking at its variability over an established time interval. This study will determine whether the $\delta^{15}N$ signature of tissue varies the longer it is submerged in a body of water and if so, could be used to establish a postmortem submersion interval. Additionally, we examined whether variance in $\delta^{15}N$ could be used to geolocate the tissue to a water body. This study presents isotope-ratio mass spectrometry (IRMS) data from sectionalized pig belly muscle submerged in 3 water baths (2 waterbodies around the Washington, DC area and 1 de-ionized control) compared to one waterless control. If a submersion interval can be established from $\delta^{15}N$ variance, it demonstrates the potential utility of nitrogen isotopes in this sphere of forensic science. This viability analysis potentially allows us to expand the avenues of post mortem interval analysis concerning aquatic recovery.

Natural Sciences and Mathematics

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ABSTRACT

Mapping and Exploring the Cis-Regulatory Landscape of Lepidoptera

Organisms, in all of their diversity, have a limited number of developmental genes to call upon. To create such complexity out of limited parts, these genes must be reused for different functions in different contexts. To do so, non-coding cis-regulatory modules (CRMs) allow for precise control of genes' spatiotemporal expression.

While these CRMs play a crucial role in development, they are much less understood than coding genes themselves largely due to the difficulty identifying CRMs in the genome. To achieve low-cost, accurate, genome-wide cis-regulatory site prediction I've used a machine learning algorithm called SCRMShaw corroborated with ATAC-seq. SCRMShaw has been trained using Drosophila to learn subtle contextual indicators about what regions are CRMs and has been shown to successfully identify CRMs in other Holometabola, such as Anopheles and Tribolium. ATAC-seq is an in-vivo technique that reveals open-chromatin regions, needed for cis-regulatory function, and has become standard to identify cis-regulatory regions active during development. Together these techniques create a robust map of CRMs genome-wide.

The resulting map is being tested at developmentally significant locations using CRISPR mutagenesis to knock out the CRMs in question. This provides further confirmation and insight into the CRMs' functionality. However, to do so there must be a clear phenotype to match to the knocked-out CRM. This phenotypic connection is readily available for CRMs linked to genes responsible for Lepidoptera wing development and patterning. Lepidopteran wings provide an excellent system to study developmental regulatory networks as they display diverse and modular patterns and are experimentally amenable to reverse genetics using CRISPR knock-outs. Additionally, targeting the CRM of a developmental gene over the gene itself will lead to knockouts with higher penetrance, that is spatiotemporally restricted, and a lower lethality. This allows for stronger phenotypes of gene knockouts in regions and developmental stages of interest. Genes that have lethal knockouts may now be studied through knockouts of their CRMs.

Natural Sciences and Mathematics

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Erik Rodriguez

ABSTRACT

Fluorescent Protein Nanoparticles as Tools to Elucidate Biology

Nanoparticles are excellent imaging agents for cancer, but metal nanoparticles and dendrimers are racemic mixtures, metals are toxic, and irreproducible size production limits approval by the FDA. Usage of fluorescent protein nanoparticles avoids these issues and is fluorescent without chemical modification. We developed a small ultra-red fluorescent protein, named smURFP, that fluoresces in the far-red, is photostable, and easily purified in large amounts. In this research, the fluorescent protein was combined with bovine serum albumin to synthesize fluorescent nanoparticles, which are stable and have a long shelf life at room temperature. I synthesized three nanoparticles with sizes of 100, 12-14, or 2.5-4.5 nm in diameter. The smallest nanoparticles were produced with only fluorescent protein. Fluorescent protein nanoparticles can encapsulate small molecule dyes without chemical attachment of the dyes. The fluorescent protein nanoparticles were incubated at different concentrations with human embryonic kidney cells, and fluorescent protein nanoparticles show little non-specific uptake inside cells. The fluorescent protein nanoparticles were used for in vivo fluorescent imaging of tumor xenografts. The fluorescent protein nanoparticles accumulate in lung cancer (A549) tumors and are removed by the liver, spleen, and lung. The fluorescent protein nanoparticles are stable in mice for at least 24 h, because fluorescence is visible in the tumor and clearance organs. In a related project, the free fluorescent protein and fluorescent protein nanoparticles are used as imaging agents to visualize ultrasound delivery in rabbit corneas with single cell resolution. The fluorescent protein nanoparticles can be chemically modified to go beyond the limits of nature to target metastatic cancer in vivo, add drugs for treatment, and guided surgery using dual-modality imaging with radioactive fluoride for positron emission tomography and fluorescence in humans.

Natural Sciences and Mathematics

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ABSTRACT

Application of Machine Learning to π0 Photoproduction

Confirming the existence of elementary particles and their excited states requires extremely precise measurements of energies released in collisions between composite particles. π0 photoproduction can be achieved by blasting protons, polarized in a butanol (C_4H_9OH) targets, with photons of 0.4 – 2.4 GeV. Protons in these targets were polarized via the Dynamical Nuclear Polarization technique. However, this does not eliminate bound-nucleon reactions, which then necessitates the target of interest in this experiment. In measurements done at the CLAS detector in Hall B at the Thomas Jefferson National Accelerator Facility, carbon targets were added downstream of the butanol to then subtract the background from bound-nucleon reactions.

The cooling system used to for the carbon targets was defective and developed patches of ice, which then produced erroneous data in what was collected. Traditional methods of correcting this type issue involve throwing away large swaths of expensive data. Instead, implementing machine learning may present a viable solution without the cost of wasted data production. We developed a neural network using TensorFlow in Python that analyzed the data collected and identified which hits were associated with carbon, butanol, or polyethylene.

Once the carbon hits were extracted, it was then possible to identify training data for ice by comparing the energy distributions of the carbon and butanol. These should be relatively similar with only a multiplicative difference in magnitude, but the ice creates an irregular spike in the carbon energies. Finally, using known ice and carbon hits, it was possible to develop a second neural network that parsed the ice and carbon data. Access to training data is extremely limited, which is why we were forced to use sections of data from the experiment to train the neural network. This is not an illegitimate strategy but is difficult to balance, as using too much of the same data can lead to overtraining and overspecialization. Nevertheless, we were successful in developing this as a proof of concept to show that this technology has strong potential for implementation in nuclear experiments.

Natural Sciences and Mathematics

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ABSTRACT

Emergence of Collective Behavior in Heterogeneous Systems

Complexity encompasses many aspects of the natural world. A majority of real- world systems (e.g. biological) contain interacting objects that are heterogeneous, and thus the understanding and development of models that incorporate this heterogeneity is of interest. Many real-world complex systems/networks tend to feature internal clustering over time, and the main framework of this project will be focused on how dynamic self organized systems are affected by heterogeneous interactions. We do this by attaching an intrinsic property of "character" to the objects in the system by means of a vector which encodes the degree of a set of character traits. Analytic aggregation theory is used and generalized to include more characteristics of a complex system including being open with fluctuating numbers of objects and adaptation. We also develop and use dynamic stochastic simulations such as the Gillespie algorithm to complement the analytical results, and to gain insight into the micro-properties of the system.

Natural Sciences and Mathematics

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ABSTRACT

Experimental Approaches to Paleodiet – Investigating Effects of Wood Smoking on δ15N

Stable isotope research on bone collagen and tooth enamel is widely applied in an attempt to understand the history and range of modern human and earlier hominin diets. The nitrogen isotope system has been extensively applied to the human bioarchaeological record to predict degree of carnivory, as nitrogen isotope ratios roughly track the trophic level of an organism. Though often utilized, this proxy is subject to potential complications stemming from a limited understanding of the behavior of nitrogen isotopes in food items during pre-consumption processing steps. This experimental study investigates the impact of wood smoking on the δ15N values of animal food resources. Recent work suggests that volatilization of nitrogen-bearing biomolecules during wood-burning contributes to an altered δ15N signature of the smoke relative to the wood. We predicted that this isotopic shift would affect animal tissue during traditional wood-smoking, and would therefore affect the δ15N value of humans consuming that tissue. A matrix of three species of animal skeletal muscle and 5 species of tree wood were experimentally smoked and δ15N values measured as offset from control samples. Results show a consistent positive shift in δ15N of the tissue, along with subtle but present species differences amongst the experimental sample matrix. These results indicate that wood smoking is a food processing behavior that could potentially affect paleodietary reconstruction by the nitrogen isotopic system in certain archaeological populations. More work is underway to better understand the drivers of these shifts and investigate other important food processing behaviors.

Natural Sciences and Mathematics

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ABSTRACT

The Search for Next-Generation Photovoltaic Materials: Antimony Halides as Perovskite Candidates

As the depletion of fossil fuels continues and effects of climate change escalate, the need for renewable energy resources, such as solar cells, are becoming increasingly relevant. Perovskites, a well-documented class of materials, have been realized as promising candidates for use in next-generation solar cells. Three-dimensional lead-based perovskites are so far the most explored family of compounds, however, these materials degrade under prolonged humidity and light irradiation, and pose health risks due to the use of soluble lead salts. Low dimensional perovskites, promisingly, exhibit high long term stability. This stability however, is accomplished at the expense of photovoltaic performance such as loss of small band gap energies. Low dimensional antimony halide perovskites are a relatively unexplored family of materials that may couple improved stability with desirable photophysical properties. We present a series of previously unreported antimony halide perovskites synthesized from acidic aqueous solutions of antimony oxide and halogen substituted pyridines. Single crystals were grown, and later structurally characterized using X-ray diffraction. These compounds feature anionic one-dimesnional antimony halide chains or zero-dimensional antimony halide octahedra, which assemble into three-dimensional networks via halogen and hydrogen noncovalent interactions between ion pairs, similar to hybrid lead perovskites. Solid state absorption measurements were performed to determine the optical band gaps. Band gap energies of these materials indicate semi-conductive behavior comparable to lead-based perovskites despite their lower dimensionality. The compounds reported serve as a promising platform to further explore next-generation lead free solar cells.

Natural Sciences and Mathematics

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ABSTRACT

Chemical Tools for Fluorescence Imaging and Treatment of Cancer

One in three Americans will develop cancer in their lifetime and ~60% is caused by random genetic mutations. Antimitotic drugs prevent cell division and are often used to treat cancers, but are prone to resistance. Published fluorescent cell cycle indicators often lack detailed division of sub-mitotic phases. Lamin B1, a nuclear membrane protein, exhibits distinct morphologies between mitotic phases and gives distinct information about cellular division. We have tagged the small ultra-red fluorescent protein to human Lamin B1, and I have validated nuclear membrane morphology alignment with mitotic phase to develop a fluorescent cell cycle indicator for precise identification of mitotic phase to improve high throughput drug screening for personalized medicine and drug development. Another form of cancer treatment, photodynamic therapy, uses a photosensitizing, reactive oxygen generating molecule to kill cells upon irradiation by specific wavelengths of light. Reactive oxygen generating small molecules have poor solubility in biologically compatible solvents, while proteins and hybrid systems fail to be excited or fluoresce in the far-red for optimum tissue penetration for therapeutic purposes. The small ultra-red fluorescent protein fluoresces at 670 nm and utilizes an exogenous chromophore, biliverdin. Mammals produce 500 mg of biliverdin, a highly aromatic tetrapyrrole, per day and is responsible for the green color of bruises. Halogenating biliverdin, through bromine addition, increases reactive oxygen species production after covalent attachment to the small ultra-red fluorescent protein and exposure to light. I synthesized a brominated biliverdin analog and confirmed attachment between the analog and the small ultra-red fluorescent protein to create a reactive oxygen generator for fluorescence guided surgery and light activated cell death of individual cancer cells left post-operation. Novel chemical tools enable a new era of cancer treatment using personalized medicine to image the cell cycle of excised patient cancer cells for optimal drug(s) treatment determination and reactive oxygen generators for fluorescence guided surgery and post-operative photodynamic therapy to kill remaining cancer cells to avoid relapse.

Natural Sciences and Mathematics

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ABSTRACT

Discovery of Granulocyte-lineage Cells in the Skin of the Amphibian Xenopus Laevis

The Frog Virus 3 (FV3) ranavirus and the Batrachochytrium dendrobatidis (Bd) chytrid fungus are significantly contributing to the global amphibian declines and both pathogens target the amphibian skin In turn, our past work indicates that tadpoles and adults of the anuran Xenopus laevis amphibian express notable levels of granulocyte chemokines (cxcl8a and cxcl8b) within their skin and possess skin-resident granulocytes, which are possibly retained/homed there by these chemoattractants. Our present studies indicate that tadpoles and adult X. laevis indeed possess specific esterase-positive resident granulocytes within their epidermises, which appear to be distinct from the tadpole and adult mast cells, found predominantly in the lower dermal layers. These esterase-positive cells responded to rCXCL8a and rCXCL8b in a concentration- and CXCR1/CXCR2-dependent manner, possessed polymorphonuclear granulocyte morphology, granulocyte marker surface staining and exhibited disparate immune gene expression from conventional tadpole and adult frog granulocytes. Our past work indicates that CXCL8b recruits immunosuppressive granulocytes and here we demonstrated that enriching esterase-positive skin granulocytes with CXCL8b (but not CXCL8a) increased tadpole susceptibility to FV3 and adult frog susceptibility to Bd. Conversely, pharmacological depletion of skin-resident granulocytes also results in increased tadpole susceptibility to FV3 but did not affect the adult X. laevis Bd-susceptibility.

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ABSTRACT

Drivers of Female Sperm Storage Organ Evolution in Drosophila

Seminal receptacles are the primary sperm-storage organ in most Drosophila. Evolution of long sperm in D. melanogaster is driven by sperm competition within long seminal receptacles (SR), such that long sperm outcompete short sperm, but only in long SRs. This male-female interaction means that SR length is a mechanism of cryptic female choice, and longer SRs are more selective for long sperm. Sperm and SRs are also coevolving both across species within Drosophila and within species, likely driven by a genetic correlation and fitness benefits for both sexes. Consistent with Fisherian runaway sexual selection of male traits and female preferences, it is assumed that SR length drives evolution of sperm length, but nothing is known about what drives the evolution of SR length. The strength of sexual selection can be approximated using female remating rate, or the average time a female waits between her first and second mating.

Flies were obtained from the Drosophila Species Stock Center or collected from the wild (D. hydei) and reared on media according to species specifications. Virgins males and females were collected and maintained in 10 mL vials until sexually maturest. For each four-hour mating trial, 5 females per trial were aspirated without anesthesia into individual vials and allowed to acclimate to fresh food overnight. One or two males, depending on species, was aspirated into a female's vial, and time to mating and copulation duration were recorded. When copulation completed, the male was replaced with a new male. The time to remating and number of matings in 7 days (or 1 day for rapidly remating species) was recorded. SR length and sperm length were also noted for each species, based on new measurements or from the literature.

There was no significant correlation between remating rate and SR length ($F_{1,16} = 1.673$, $P = 0.2143$), suggesting that sexual selection is not driving the evolution of SR length on a macroevolutionary scale. However, there is a genetic correlation between SR length and sperm length, and long sperm and SR genotypes tend to increase fitness for both sexes. These factors may be enough to drive sperm-SR coevolution without selection specifically acting on SR length.

Natural Sciences and Mathematics

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ABSTRACT

Comparing Lepidoptera Distribution With Canada's Protected Areas to Inform Insect Conservation

Insects proliferate nearly all terrestrial ecosystems and dominate global animal biodiversity and biomass. However, insect populations are currently experiencing a major decline due to human-driven environmental degradation through habitat loss, climate shifts, and widespread pesticide use. Whereas conservation efforts have been primarily targeted towards charismatic species, there is a large lack of data on insect populations. This study evaluates whether protected areas conserve Lepidoptera biodiversity in temperate forests of Canada. This study uses a historic dataset of Lepidoptera in Canada, collected by the Canadian Forest Insect Survey between 1937 and 1957 for the purpose of documenting species' traits and distribution. Using QGIS, nearly 300 printed maps were digitized, resulting in over 51,484 georeferenced caterpillar collection sites across the southern half of Canada, in total documenting 266 caterpillar species. In order to assess whether protected areas in Canada conserve caterpillar diversity, species' distributions were compared to the World Database on Protected Areas. The total species richness of caterpillars was calculated in each protected area, as well as the species composition. One hypothesis of this study takes the single-large-or-several-small (SLOSS) debate into consideration, predicting that protected areas of greater size will contain greater species richness.The project further examines whether tree diversity in a given protected area is related to caterpillar richness, given that caterpillars depend on specific tree species for food. In Canada, there are 7,205 total terrestrial protected areas, of which 1.3% contain at least one of the focal caterpillar species. In total, 93% of the species occurred within at least one protected area. Caterpillars were recorded in 858 of these protected areas, and individual species occur within 15.2 protected areas on average. One of the more widespread species, Acleris variana, occurred in 123 sites, whereas 25 species were recorded in 2 or fewer sites. The Canadian Rocky Mountains Parks contained the highest species richness of all protected areas with 114 species ranging within its area. However, on a per-area basis, the Whiteshell Provincial Park supported the greatest number of species at 11 per km2. Caterpillar richness among parks was positively correlated with protected area size, indicating that bigger parks sustain more species than smaller parks. However, small protected areas in the southernmost regions of the country provide important protections to a unique fauna not captured by larger reserves. Collectively, this work demonstrates that conserving tree diversity also does well to protect herbivore diversity, and that while smaller protected areas may contain fewer species they may be very important to conserving a greater breadth of species.

Natural Sciences and Mathematics

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Neil Johnson

ABSTRACT

Infectious Disease Outbreaks and Human Migration: A Network Analysis

The world is waiting to see if the Coronavirus Disease 2019 (Covid-19) will become a pandemic. Meanwhile there has been speculation about how this, and potentially future, disease outbreaks are made worse by human movement between countries. There are many studies of the impact of human travel on the short-term dynamics of an infectious disease outbreak. However far less is known about how longer-term patterns in human movement might, or might not, relate to global patterns in infectious disease cases on the scale of years. Yet such understanding may be useful for planning process, as well as to dispel the myths and rumors that surface out of fear or prejudice against migrants from particular countries.

Here we provide a missing, system-level study of the two phenomena on the same footing. We employ network science, which is particularly good for describing the heterogeneous nature of the system, i.e. countries (encoded in the network nodes), cases and human flows (encoded in the network edges). Our methodology employs data science tools, such as igraph package, in the statistical computing and graphics development application RStudio. Our data on long-distance human movement between 1990 and 2019 is based on global migration data obtained from the United Nations. We also use the World Health Organization's influenza surveillance data. We analyze the resulting network which encodes both migration and infectious disease data, obtaining measures such as the betweenness centrality to identify countries that appear to play a key role in terms of linkages. We also quantify how central each country is to the network. In this way, our approach can help identify key target countries for possible intervention. Findings from our research offer new insights that can help government health agencies optimize public health measures, and more effectively target control efforts associated with human mobility routes.

Natural Sciences and Mathematics

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ABSTRACT

Gram Determinants in Knot Theory

In the 1990's, a general formula for the Gram determinant of Type A was formulated in order to prove the existence and uniqueness of Lickorish's construct of the Witten-Reshetikhin-Turaev invariants of 3-manifolds, this determinant is of a matrix given by a bilinear form on crossless connections in the disc with $2n$ boundary points. A decade later, general formula for the Gram determinant of Type B was solved. We generalize the Gram determinant of type A and formulate a closed formula as well as prove results that support Qi Chen's conjecture of a general closed formula for the Gram determinant of the M\"obius band.

Natural Sciences and Mathematics

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ABSTRACT

Effects of Aging and Development on Habituation to Thermal Stimuli in C. Elegans

Neural plasticity is the capacity for neurons to change throughout an individual's life. This can include habituation or sensitization. In this project, we analyze how habituation to thermal stimuli in C. elegans is affected by the age of the worms. Our experimental apparatus consists of an open-frame microscope with a 1480 nm IR laser adapted to provide thermal stimulation through the objective. This wavelength will optimize the amount of heat that is absorbed by the worm, which will increase the efficiency and rate of heating, or ramp rate. Early work by Aylia Mohammadi and coauthors has shown that the strength and speed of the worm's response increases with ramp rate, making this wavelength of light important. Stimulating a worm for 2ms is enough to elicit a response, but not harm the neurons. Videos of the worms are captured through a USB interface.

Worms are stimulated on the head with the laser while video is captured. This is repeated until the worm does not respond. For each laser pulse, the worm is tracked in image processing software. From this, the worm's response time to the stimulus, and the distance, velocity, and acceleration of the worm due to the stimulation. Preliminary results show that reaction time does not slow as the worms are stimulated, up to the point where the reaction stops, although the distance moved does decrease.

To test the effect of the age of the worms, C. elegans of different ages have been tested, including larval stages 1-4, day 1 adults, and day 6 adults. These ages were chosen to determine the effects of development and aging. It is hypothesized that once thermal receptors are developed, between larval stages 2 and 3, the youngest worms will be the most responsive, with cognitive decline in the older adults. This decline will be represented as slower response times and less distance traveled in the day 6 adults compared to the day 1 adults. Before thermal receptors have fully developed, in larval stages 1-2, the worms are not expected to be responsive to the thermal stimuli.

Natural Sciences and Mathematics

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Ioannis Eleftherianos

ABSTRACT

A Putative UDP-glycosyltransferase from Heterorhabditis Bacteriophora Suppresses Antimicrobial Peptide Gene Expression and Ecdysone-reliant Signaling

Insect immunology generally addresses host-pathogen interactions at the level of effectors that contact the pathogen directly, typically cellular responses like encapsulation or humoral responses like the production of AMPs. This is a crucial aspect of these interactions, but the mechanisms that regulate these processes must also be considered, including the ecdysone-based signaling infrastructure that coordinates and enables certain branches of immunity. Some insect pathogens, specifically members of the family Baculoviridae, manipulate this system to the advantage of the pathogen, and information presented herein indicates that the entomopathogenic nematode Heterorhabditis bacteriophora may employ a similar strategy. Previously, we identified a putative ecdysteroid glycosyltransferase, Hba_07292, from the transcriptome of hemolymph-activated H. bacteriophora. Here we expressed this putative ecdysteroid glycosyltransferase in recombinant form (rHba_07292) and examined its impact on the immune response of Drosophila melanogaster. Notably, rHba_07292 suppressed the gene expression of antimicrobial peptides associated with both the Toll and Imd pathways. This suppression was further implicated as a byproduct of ecdysone-based immune regulation through the reduced expression of the ecdysone-responsive transcription factor Broad Complex. Moreover, Drosophila injected with the rHba_07292 exhibited reduced pupation rates, concurrent with increased glycosyltransferase activity in the secreted products of H. bacteriophora. Together, our findings indicate that H. bacteriophora secretes an ecdysteroid glycosyltransferase as a virulence factor and that the resulting activity has strong limiting effects on the immune response of Drosophila.

Natural Sciences and Mathematics

Columbian College of Arts and Sciences

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Andrei Afanasev

ABSTRACT

Acoustic Vortex Tweezers for Biomedical Research

Contactless manipulation of biological samples and proteins has become vital to many modern biomedical and pharmaceutical research methods. The most used form of contactless manipulation currently are optical tweezers which rely on the electromagnetic radiation pressure. However, the radiation pressure is proportional to the intensity of the electromagnetic field over the speed of propagation of the optical source. In order to obtain pico-Newtons of force the light intensity must be on the order of 108 W/cm2. The high intensities required for optical tweezers may cause unwanted heating or damage to delicate biological samples. The sample must also be transparent for the optical tweezers to function. Another method of contactless manipulation, acoustic trapping, could be used instead of optical trapping. Surface Acoustic Waves (SAWs) propagate on the order of 105 times slower than electromagnetic waves and therefore require less intensity for equivalent forces. Acoustic trapping can be accomplished by creating a vortex on the surface of a piezoelectric substance. The vortex can be generated through a spiral of interdigital transducers on the surface of the piezoelectric substance, which are programmed to offset the phase of individual SAWs so their superposition results in a vortex with a phase singularity at the center of total destructive interference. This has been accomplished with SAWs in the frequency range of a few MHz, but this range limits the size of manipulatable samples to 70 μm. The goal of our research is to design and produce an Acoustic Vortex Tweezer that uses SAWs in the frequency range of 100 MHz to 1 GHz in order to allow for the manipulation of samples in the micron and sub-micron range. Acoustic trapping can be used in biomedical and pharmaceutical research as a form of contactless manipulation without the drawbacks of unwanted heating and damage to biological samples. Simulations on Wolfram Mathematica were used to determine properties of the acoustic vortices such as pressure fields, phase and group velocity, and shear force based on a variable topological charge of the piezoelectric substance. To date the results support the phase singularity in the middle of the vortex and a pressure gradient towards it, which indicates successful acoustic trapping of a given sample.

Natural Sciences and Mathematics

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ABSTRACT

Characterizing Non-Canonical Wnt Signal Transduction in Vanessa Cardui

The process of development and cell differentiation is a highly conserved and vitally important one among many organisms, and an extremely significant mechanism that informs this process is the Wnt signal transduction pathway. The canonical Wnt signaling pathway is defined by interactions between the WntA/Fz2 and TCF/beta-catenin protein complexes. However, it also includes a number of poorly-characterized "non-canonical" branches. Determining whether a biological system makes use of a non-canonical branch is significant for the field of developmental biology; in our study, we aim to focus on the system of lepidopteran wing pattern formation to determine whether it uses one such non-canonical pathway.

By using CRISPR/Cas9, a protein-ribonucleotide complex that induces targeted double-stranded breaks in genomic DNA, we can produce organisms that exhibit genetic mosaicism with respect to beta-catenin and TCF knockouts. Lepidopterans such as Vanessa cardui are the ideal model organism for this study, as their wing patterns are made up of individual scales secreted by single cells, allowing CRISPR/Cas9-mediated mosaicism to be easily visualized. Determining whether these mosaic knockout organisms display the same phenotypes as those with WntA/Fz2 knockouts allows us to draw conclusions about the function of beta-catenin and TCF. A beta-catenin/TCF inhibitor drug, PKF119-310, can also be used to corroborate data gained from the CRISPR/Cas9 knockout study.

Tentative evidence suggests the presence of a novel, non-canonical signaling pathway involving WntA and Fz2 that results in butterfly wing pattern formation. The presence of such a pathway has exciting implications for the field of developmental biology and paves the way for the future study of even more nuanced cell signaling cascades.

Natural Sciences and Mathematics

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Anthony LaMantia

ABSTRACT

Examining Callosal Commissural Fibers and Glia in 22q11.2 Deletion Syndrome

Connectivity within the cerebral cortex, particularly the cortical association areas has been shown to be disrupted in neurodevelopmental disorders, including the 22q11.2 deletion syndrome (22q11DS). In cortical layer 2/3 projection neurons, reduced 22q11 gene dosage diminishes axon and dendritic growth and disrupts mitochondrial and synaptic integrity. Using the LgDel 22q11DS mouse model, we assessed long-distance projections by measuring the axons of the corpus callosum (CC). High-resolution large area SEM images were taken at five evenly spaced points along the anterior to posterior axis of the CC. To our knowledge, this is the first time that thousands of 80x images have been stitched together to generate coronal slices of such size and detail. The data was quantified using Arivis software via semi-automatic measurements of the segmented axons. Specifically, we compared the number and average surface area of CC axons and glia between wild type and LgDel animals. In addition, we are also examining glial cells that have infiltrated the axonal tracts as markers of stress. Currently, analysis and data gathering are still ongoing.

Natural Sciences and Mathematics

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ABSTRACT

Pollinator Biodiversity Study of DC College Campuses

Impactful declines in pollinator groups such as bees, butterflies, and flies have been attributed to pesticides, extreme weather, habitat destruction/fragmentation, and other urbanization disturbances. Aware of these concerns, we tracked the abundance and diversity of local pollinators on urban college campuses in DC. We predicted that the green spaces at American University would promote greater pollinator diversity and abundance than the green spaces at the George Washington University due to their increased size, plant density and native variety, and isolation from pedestrian/automobile disturbances. Once a week, we surveyed three green spaces at both GWU and AU. Surveying involved identifying insects, recording the total number of pollinator visitors, and capturing unfamiliar specimens with an aspirator or net. Each researcher studied four plants per day for twenty minutes each. Our preliminary results revealed that the green spaces at AU supported a greater abundance and diversity of pollinators than those at GWU. Specifically, statistical analysis showed that the AU plots experienced a greater average visitation of Apidae, Halictidae, Syrphidae, Scarabaeidae, Miridae, Berytidae, and Dolichopodidae pollinators than the GWU plots. Furthermore, while all the pollinator families observed at GWU were also identified at AU, pollinators from three different families, Ulidiidae, Hesperiidae, and Pieridae, were solely detected on the AU campus. It was clear from observing the same flowers on each campus that the plots on AU campus fostered a larger variety of pollinators, as well as a higher daily quantity of them than GWU. In addition to receiving nearly double the daily Apidae visitations observed on the GWU Echinacea flower, the AU Echinacea plant also showcased an increasing trend in Apidae abundances. We attributed the greater pollinator diversity and abundance of AU's green spaces primarily to the increased variety of plant species that were present. Additionally, the larger size of the AU green spaces, which had an average area of 1642.76 ft2 compared to the GWU plot average area of 788.92 ft2, likely contributed to the greater pollinator variety and abundance. Finally, the impressive density of plants (AU average density = 0.09 plants/ft2, GWU average density = 0.036 plants/ft2, p-value = 0.0436) and greater separation from disturbances of the AU plots increased the biodiversity of pollinators observed on that campus.

Natural Sciences and Mathematics

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Claire Besson

ABSTRACT

Synthesis of Goblet-shaped Tricyclopentadienyl Lanthanoid Molecules

Lanthanoid complexes are extensively studied because of their interesting magnetic properties, in particular strong magnetic anisotropies. The anisotropy-induced bistability of the complexes makes them good magnetic quantum bits. Furthermore, the geometry, and contacting environment of isolated complexes are crucially important for their magnetic properties and electrical accessibility. The final goal of this research is to create a goblet-shaped molecule, with a tricyclopentadienyl bowl holding a lanthanoid cation, a chain of suitable length and rigidity, and a flat aromatic core ensuring a strong interaction with a metallic surface. This specially designed geometry will allow us to probe the electric and magnetic properties of the complexes with scanning tunneling microscopy after deposition.

In our first studies, benzene was selected as the central core for tricyclopentadienyl ligands. While the surface of this simplest of aromatic is small, it offers a promising platform for testing the synthesis of diverse libraries of trisubstituted molecules. We present here the attachment of C2 linkers to a variety of benzene cores with aim for a short and effective route to a trisubstituted molecule. In our experiments, we were able to optimize the reaction conditions to selectively obtain a trisubstituted benzene ring with a promising leaving group to attach the cyclopentadienyl ligand.

Natural Sciences and Mathematics

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ABSTRACT

An Independence Test for Functional Data

Pearson correlation is the predominant measure to quantify functional connectivity for human brain signals. It is well known that Pearson correlation can only detect linear associations, but the dependency between human brain signals is far more complex than being linear. Under the framework of functional data analysis, we regard the signals from two brain regions as two random functions and propose a new dependency measure for functional connectivity. The new measure can be used to detect more complex dependency structures since it is zero if and only if the two random functions are independent. The large-sample performance of the proposed method is theoretically guaranteed. Its finite-sample performance is assessed by a simulation study and its sensitivity and specificity are substantially outperform other existing methods. Applied to a magnetoencephalography (MEG) data from the Human Connectome Project, the proposed method is capable of finding more interpretable task-related human regions than Pearson correlation.

Natural Sciences and Mathematics

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ABSTRACT

Skein Modules and Framing Changes of Links in 3-Manifolds

The framing of a knot K in an oriented 3-manifold remains unchanged unless there exists a properly embedded non-separating 2-sphere which intersects K exactly once; in which case, the change of framing is given by the Dirac trick. Since 1987, when Przytycki introduced skein modules, these have been extensively studied with the goal of building an algebraic topology based on knots. In this talk, we formulate the results on the framing of knots in the language of skein modules.

Natural Sciences and Mathematics

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Amy Zanne

ABSTRACT

Simulated Wood: Lignin Photodegradation

Lignin accounts for nearly 30% of organic carbon released by plants annually; it is second in abundance as a polymer only to cellulose within the biosphere. Lignin is essential in providing structural integrity to plant cell walls and protecting the cellulose and hemicellulose of the plant from microbes that cause decomposition. Only a few microbes (namely white-rot fungi) and solar radiation (via photodegradation) are capable of breaking down lignin. Because lignin is photoreactive absorbing a variety of wavelengths, it is the principal compound in wood degraded by solar radiation. Once lignin is degraded, microbes have increased access to the cellulose and hemicellulose, leading to further carbon loss from wood. This interaction between solar radiation and microbial decomposition is especially important in dry or seasonal biomes with open canopies where direct sunlight reaches deadwood on the ground. While microbial biotic lignin decomposition is relatively well studied, fewer studies have explored the effect of solar radiation on lignin degradation, especially in wood. Here we show that lignin loss in stacked lignin impregnated filter papers (simulated wood) is driven by solar radiation. Our results show that filter papers exposed to all wavelengths experience the most lignin loss, and filter papers not exposed to solar radiation experience no lignin loss. Results from the first harvest suggest that light effects attenuate at the first of the 3 stacked filters. Furthermore, we found a weak positive relationship between mass loss and lignin loss. Observing lignin from a climate change perspective can contribute to a greater understanding of lignin's photoreactivity and carbon turnover rates.

Natural Sciences and Mathematics

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Frank Lee

ABSTRACT

Electric Polarizability of Hadrons from Lattice QCD

Electric and magnetic polarizabilities are two of the fundamental properties of hadrons which help us understand the distribution of charge and currents inside hadrons and how they respond to external electromagnetic fields. For nucleons, these values are determined experimentally from Compton scattering. For charged pions, the experiments are more challenging since no free pion target is available and the results are less precise, but a number of experiments are planned that will improve the accuracy. Lattice QCD can be used to compute hadron properties as determined by quark and gluon dynamics, providing results that are complementary to other theoretical approaches. In this presentation I will review the lattice QCD methods used to compute hadron polarizabilities, focusing on electric polarizability, and present our results.

Natural Sciences and Mathematics

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ABSTRACT

TGF-β Signaling Pathway Modulates Drosophila Innate Immune Response Against Infection with H. Bacteriophora Parasitic Nematodes

Heterorhabditis nematodes live in a mutualistic relationship with Photorhabdus bacteria and together they infect a wide range of insects, including Drosophila melanogaster. A major advantage of these parasitic nematodes is that they are viable in the absence of their mutualistic bacteria, and both axenic (lacking the associated bacteria) and symbiotic (containing bacteria) nematodes can infect and kill Drosophila. Transforming Growth Factor-β (TGF-β) signaling pathway has a significant role in modulating antibacterial and anti-nematode immune response in Drosophila. Recently, it has been shown that the Activin and Bone Morphogenetic Protein (BMP) branches of the TGF-ß signaling pathway contribute to the immune response of Drosophila larvae against infection with H. gerrardi nematodes. However, understanding whether the interaction between TGF-ß signaling and the Drosophila anti-nematode immune response is regulated by the nematodes alone without any potential effect from their naturally found bacterial symbionts, remains incomplete. Therefore, here we investigated the interaction between Activin and BMP signaling activity with the Drosophila immune response against infection with axenic or symbiotic H. bacteriophora nematodes. For this, we introduced axenic or symbiotic H. bacteriophora nematodes into Drosophila larvae carrying loss-of-function mutations in the extracellular ligand genes daw or dpp and estimated their survival ability and immune activity. We found that dpp mutants have lower survival ability upon infection with axenic or symbiotic nematodes compared to their background control, and both daw and dpp mutants contain fewer circulating hemocytes at three hours post-infection with axenic H. bacteriophora. In addition, we observed that dpp mutants infected with axenic H. bacteriophora express Duox, the enzyme mediating reactive oxygen species (ROS) response, at higher levels compared to their background control. Finally, phenoloxidase enzyme activity is reduced in dpp mutants upon axenic or symbiotic H. bacteriophora infection compared to uninfected individuals, while daw mutants infected with axenic or symbiotic nematodes contain higher levels of prophenoloxidase protein compared to uninfected larvae. Overall, findings of this study show that the BMP branch of the TGF-ß signaling contributes to the survival ability of the host and modulate the ROS response, while both Activin and BMP branches regulate hemocyte numbers and phenoloxidase activity in response to parasitic H. bacteriophora infection.

Natural Sciences and Mathematics

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Andrei Afanasev

ABSTRACT

Quantum Backflow in Light Beams

Regions of light beams with positive momentum have been found to propagate in the negative direction, creating backflow. Specifically looking at beams carrying additional orbital angular momentum, this project will investigate areas of backflow in these light beams. In previous study, these beams were characterized by their phase singularity structure. The singularities of phase structure in light are related to regions of backflow. In this project measurable regions of backflow have been identified in co-propagating beams of opposite helicity. Backflow in light corresponds closely to quantum superoscillations and weak measurements of the local wavenumber of light beams.

Natural Sciences and Mathematics

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ABSTRACT

Histological Diversification in the Muscular Anatomy of the Palatal Organ with Cypriniformes

Cypriniform fishes are characterized by several trophic novelties that have likely played an important role in the evolutionary success of this group. One such novelty, the palatal organ, is a dorsal mass of complexly arranged muscle fibers within the buccopharyngeal cavity tied to the branchial elements laterally and to the chewing pad caudally. In goldfish and carp this muscular pad is incredibly well innervated and produces localized protrusions that are used to trap edible items while bottom feeding. The palatal organ has only been investigated in those species with either a greatly hypertrophied vagal lobe (goldfish and carp) or species with a greatly hypertrophied palatal organ (Catostomidae and a few cyprinids). There is no comparative data on the histological structure of the palatal organ across the whole of Cypriniformes. The general assumption has been that the function of the palatal organ is conserved across cypriniforms, and requires the careful control made possible by a hypertrophied vagal lobe to function properly. Few have considered the possibility that the palatal organ may have become adapted for different functions during cypriniform evolution. However, before formulating testable functional hypotheses, the histological structure of the palatal organ in a diverse group of cypriniforms must first be analyzed. In this study, we investigate the muscular composition of palatal organs within 39 species, within several families. There was not a consistent difference in muscular architecture between members of Cobitoidea and Cyprinoidea. Nearly all species examined have some type of muscular palatal organ, characterized by a complex mesh of differently sized muscle fibers. One exception is <i>Gyrinocheilus </i>, which has very reduced muscularity of the palatal organ.

Natural Sciences and Mathematics

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RESEARCH MENTOR/DEPARTMENT CHAIR

Ioannis Eleftherianos

ABSTRACT

Interaction Between the TGF-β Ssignaling Pathway and Drosophila Carbohydrate Metabolism

Drosophila melanogaster is an excellent model organism to study metabolic processes due to its ease of culture, genetic accessibility, and well conserved pathways such as the Transforming Growth Factor-β (TGF-β) signaling pathway. Recently, the two signaling branches of the TGF-β signaling pathway, Activin and Bone Morphogenetic Protein (BMP), have been shown to participate in the D. melanogaster metabolic response to infection with the parasitic nematode, Heterorhabditis gerrardi. In this study, we used H. bacteriophora which belongs to the same genus as H gerrardi. To investigate the effects of the nematode infection without assistance from its symbiont we generated and used axenic (lacking P. luminescens) nematodes. Our aim was to investigate the interaction between the TGF-β signaling pathway and D. melanogaster carbohydrate metabolism upon axenic (lacking Photorhabdus luminescens bacteria) or symbiotic (containing P. luminescens) H. bacteriophora infection. To interfere with TGF-β signaling activity, we used D. melanogaster larvae carrying loss-of-function mutations in the genes coding for the Daw (Activin signaling) and Dpp (BMP signaling) extracellular ligands as well as their background controls. To quantify trehalose, glucose, and glycogen levels in D. melanogaster larvae, we used plate reader-based assays. We found elevated trehalose levels in background control larvae infected with symbiotic nematodes compared to uninfected individuals. Also, dpp mutant larvae infected with symbiotic H. bacteriophora had significantly higher trehalose levels than those infected with axenic nematodes. However, trehalose levels were significantly lower in daw mutant larvae infected with symbiotic nematodes compared to uninfected controls. Daw mutant larvae also contained higher trehalose and lower glucose levels compared to background controls in the presence or absence of infection. Daw mutants further displayed increased glucose concentration upon infection with symbiotic nematodes compared to uninfected larvae. Finally, there was no significant change in the amount of glycogen in neither the mutants nor the control larvae for any of the treatments. Overall, these findings suggest that the TGF-β signaling pathway might regulate D. melanogaster sugar metabolism in response to parasitic nematode infection. Results obtained from this and other similar studies might contribute towards the development of novel treatment strategies for combating parasitic nematode infections in humans.

Natural Sciences and Mathematics

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Daniele Podini

ABSTRACT

A Multivariate Statistical Approach for Enhancing Ancestry Prediction from Microhaplotype Data

Microhaplotypes (MHs) are newly developed multi-allelic markers of at least two single nucleotide polymorphisms (SNPs) within < 300 bp. Due to presence of small amplicons and low recombination rate, absence of stutter and preferential amplification, they are promising candidates for human identification, mixture deconvolution and biogeographical ancestry (BGA) prediction. The global interest in BGA inference aims to maximize the amount of forensically relevant information retrievable from DNA evidence when no STR profile is obtained. Current protocols for ethnic origin estimation are generally based on Principal Component Analysis (PCA) and Bayesian approaches. In our early study we demonstrated the capability of multivariate statistical tools to predict the ancestry affiliation from autosomal STR (short tandem repeat) data. In this study we aimed to extend this alternative and dynamic statistical approach to the analysis of microhaplotype data.

Multivariate techniques such as Partial Least Squares-Discriminant Analysis (PLS-DA) and Support Vector Machines (SVM) were used for the analysis of microhaplotype profile from an initial set of 347 individuals from four US population groups (88 Afro-American 'AA', 114 European-American 'EA', 102 Southwest Hispanic 'His' and 43 East-Asian American 'EAA'). The DNA samples were typed using a bioassay of 74 MHs on the ion S5TM sequencing platform [2,4]. Overall both PLS-DA and SVM approaches significantly improved ancestry inference by enhancing the separation of the four populations clusters. Furthermore, PLS-DA results were used to assess the accuracy of ethnic affiliation for 4 test individuals, one per each reference population group to test their ancestry affiliation in terms of likelihood ratio (LR). The resulting LR values provide an indication of how much more likely it is to observe the MH profile of interest if it originated from the test population at the numerator than if it originated from the other three populations at the denominator. LR values for each of the 4 test individuals confirmed the correct ancestry affiliation and in particular, LR= 1099, LR=1062, LR= 104 and LR= 101 were obtained for AA, EAA, EA and His, respectively. Overall high LR values were observed for well-genetically defined populations while lower values from admixed ones, as expected.

This multivariate statistical approach will be shortly implemented in an open-source and user-friendly R Shiny app to assist law enforcement agencies and DNA analysts with the interpretation of ancestry data.

Natural Sciences and Mathematics

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ABSTRACT

Testing East Turkana Bovid Mortality Profiles Using Site-specific Data

Hominins have accessed ungulates as meat resources for at least 1.5 million years, but their carcass acquisition strategies are less well-known. Bovid mortality profiles demonstrate that hominins increasingly targeted prime-aged adults through time. A previous study inferred a prime-age signal for bovids in East Turkana between ~1.8-1.4 Ma, but the interpretations were limited because the study assessed broad subregions rather than specific sites. This study examines bovid mortality profiles at specific sites within East Turkana where there is clear evidence of hominin carnivory.

In 2019, we recovered 64 fossil bovid molars from two sites in Areas 1A (Okote Member) and 8A (KBS Member) to test whether prime-dominated profiles exist at the site level in the presence of hominin butchery. Three age classes were utilized based on molar infundibular occlusal wear: juvenile (little to no wear), prime adult (moderate wear), and old adult (severe wear). Mortality profiles for the two sites were created using triangular graphing software and compared to Kanjera South, FLK-Zinjanthropus, and modern lion- and hyena-killed bovid profiles.

Results support the inference that prime-dominated hunting by hominins occurred at the site-level in the presence of butchery in East Turkana. We approximated 95% confidence intervals around the data points using bootstrapping. Both site profiles were significantly different from the modern carnivore profiles and the Kanjera South Profile. However, the results may have biases due to variability in taphonomic preservation, as fragile bones of younger individuals are less likely to preserve and may be underrepresented.

Natural Sciences and Mathematics

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Alexander van der Horst

ABSTRACT

Simulating Dark Gamma-Ray Bursts to Understand SCORPIO Capabilities and Host Galaxy Conditions

The construction and implementation of SCORPIO (Spectrograph and Camera for Observations of Rapid Phenomena in the Infrared and Optical) at the Gemini Observatory will allow for imaging observations in the g, r, i, z, Y, J, H, and Ks bands, and spectroscopy over a range of 385-2350 nanometers. This research examines the proposed use of SCORPIO to analyze optically dark gamma-ray bursts (GRBs) by running simulations under different extinction conditions in their host galaxies. Dark GRBs are defined as those with a very low optical brightness compared to their X-ray brightness, specifically in their afterglows. An afterglow of a GRB refers to the collision between the blast wave of the initial explosion and the the gas and dust in the interstellar medium of the host galaxy, which then gives off a fainter signal. The simulations will cover studies of GRBs of varying brightness, spectra, and environments. A better understanding of dark GRBs, as well as host galaxy extinction, requires early-time observations in multiple wavelengths. SCORPIO will allow for such observations, and this research will point SCORPIO in the right direction to be able to better categorize and analyze dark GRBs, their host galaxies, and the extinction responsible for the loss of optical light in the GRB afterglow.

Natural Sciences and Mathematics

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J. Houston Miller

ABSTRACT

Investigating the Nanostructure of Soot-based Pigments Using Raman Spectroscopy and Transmission Electron Microscopy

Soot has been used as an artists' pigment for millenia and is a major component of the ink (Chinese: 墨Mò; Japanese: 墨 Sumi; Korean: 먹 Meok) used in East Asian calligraphy and paintings. While an important part of the cultural heritage of China, Japan, and Korea, ink has shown to be difficult to analyze scientifically, particularly using methods that do not require removing a sample. This poster examines the different types of soot used in ink, both traditionally and in modern times, using non-invasive Raman spectroscopy. The distinct methods of manufacturing pine soot, lamp black, and carbon black lead to variations in the structure of the soot, allowing for differentiation in soot type using Raman spectroscopy. Traditional lamp black has a more graphitic structure than the other soots examined due to the extended heating time during manufacture of the soot. Transmission electron microscopy (TEM) has been able to confirm the variations in soot structure suggested by Raman spectroscopy. The properties of pine soot varied considerably, presumably because of the different techniques that can be used to make pine soot, while the modern lamp blacks most closely resembled carbon black due to the similarities in manufacturing carbon black with the modern methods of making lamp black in China.

Natural Sciences and Mathematics

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ABSTRACT

The Roles of Amphibian (Xenopus laevis) Macrophages During Chronic Infections with the Frog Virus 3 Ranavirus

Ranaviruses such as the Frog Virus 3 (FV3) are significantly contributing to the global amphibian declines. The anuran amphibian Xenopus laevis is an ideal platform to study amphibian antiranaviral immunity, including the roles of distinct frog immune populations to this pathogen. Notably, frog macrophages (MΦs) are believed to be important during FV3 infections, wherein they are thought to play important roles in both viral dissemination/persistence and the immune defense against the virus. In turn, MΦ differentiation and functionality depend on signaling through the colony-stimulating factor-1 receptor (CSF-1R), which binds to CSF-1 and interleukin-34 (IL-34) cytokines, giving rise to two functionally and phenotypically different subsets of MΦ populations. Our past studies indicate that the X. laevis CSF-1-derived MΦs (CSF-1-MΦ) are more susceptible to FV3 infections whereas IL-34-derived MΦs (IL-34-MΦ) confer anti-FV3 protection. Because FV3 is known to persist within its frog hosts for prolonged periods of time, presently we examined the roles of X. laevis CSF-1- and IL-34-MΦs during chronic (1 month) infections with this infectious agent, focusing on the frog kidneys, which represent a central site of FV3 replication. Our findings indicate that frogs enriched for CSF-1-MΦs developed more robust kidney reservoirs of the virus while animals enriched for IL-34-MΦs exhibited lower kidney FV3 loads after 1 month of infection. Stimulating chronically FV3-infected frogs with recombinant (r)CSF-1 similarly resulted in expansion of these animals' viral reservoirs while rIL-34 treatment reduced animal kidney FV3 loads. Moreover, CSF-1- and IL-34-MΦ-enriched and FV3-challeneged animals possessed disparate immune and viral gene expression patterns, confirming that these respective MΦ populations result in distinct immune outcomes during FV3 infections.

Natural Sciences and Mathematics

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ABSTRACT

Making The Proteins Linked To Hormone Inducible Breast Cancer For Protein-Protein Binding Studies

While it is widely known that a mutation in the BRCA1 gene causes breast cancer in women, hormone imbalances also can also cause breast cancer, observed with 1 in 8 women in America. In these types of cancers, cells feed on either estrogen or progesterone, resulting in uncontrollable cell growth. Nearly 67% of all breast cancer cases are in some way affected by hormonal issues such as these. There is little research or understanding on the connection between hormone levels and proteins and their effects on hormone inducible breast cancer. The UBR5 protein is observed to be overexpressed in these cells. The PABC domain of UBR5 binds to the C-terminus of alpha4C that consequently leads to a decrease in PP2A, an enzyme essential to regulate the cell cycle. We are interested in characterizing the interaction of PABC and alpha4 C-terminus. To achieve this, we first must produce these proteins in large quantities to study by NMR spectroscopy. We use bacterial (E. coli) cells to produce engineered version of these proteins. The major challenge and the focus on this presentation is producing large quantities of soluble forms of these proteins. We present approaches used to optimize protein production and preliminary data to understand the structures of these proteins.

Natural Sciences and Mathematics

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ABSTRACT

A Study on Improvements for Modern Ring Imaging Cherenkov Detectors

To learn about the most fundamental building blocks of nature, accelerators are used to probe the nucleus of the atom and investigate their internal structure. The types of particles produced in the nucleus disintegration can be determined based on their mass and momentum after collision. Ring Imaging Cherenkov Detectors are used to identify particles based on the emission angle of the so-called Cherenkov radiation, which can be related to the particles' velocity. Modern RICH detectors utilize optical tools for modifying the trajectory of photons before their detection creating a challenge in particle identification that requires greater control over optical properties of all components of the detector. In this study I have investigated the possibility of using a neural networks algorithm to distinguish the radiation distribution of different particles (kaons, pions, electrons, and protons) in hopes of identifying them accurately. As a proof of concept I have realized a realistic simulation of a RICH detector using "Geant4" to generate training and testing datasets representing different accelerated particles' behavior in the detector. To improve precision the optical properties of the radiator material are incorporated in the simulation algorithm. Optical tests with a spectrophotometer have been performed on sample tiles of the radiator material in order to establish a procedure for the RICH detector under construction for Hall B at Jefferson Laboratory.

Natural Sciences and Mathematics

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ABSTRACT

Are Less Picky Eating Caterpillars Found in Broader Regions?

An herbivore's diet breadth (DB) , or the number of consumed plant species, is driven by coevolution with its host plants, often resulting in specialization to related hosts.In temperate regions herbivores tend to be more generalized and adapted to feeding from many plants, but little is known of the life history trade-offs associated with a more generalized strategy. One plausible explanation is having broader diets allows species to occupy broader ecological niches, which may be beneficial for temperate species that are subject to harsher and more variable abiotic conditions. We predicted that more generalized species should have larger geographic distribution.

Using a dataset of 79 species of geometridae, 28 genera of tree genera associations in Canada, we measure the DB of Geometridae (Lepidoptera), and DB is quantified in terms of taxonomic and phylogenetic richness. Diet taxonomic richness was measured as the numbers of tree genera a species was collected from. Additionally, we calculate dietary phylogenetic diversity as Faith's PD, or the sum of phylogeny branch lengths. Using phylogenetic diversity metrics have important value in measuring DB because more distantly related hosts should be more different in traits for consumption, i.e. plant secondary chemistry.

We hypothesized that a species DB should be positively related to broader a geographic range because specialized caterpillar species' range must be restricted to the range of its associated host plant. Being able to survive in broader ranges should mean that a species is successful feeding on the plants in these wider range.

To test this hypothesis we digitized and georeferenced a series of maps detailing caterpillar collection sites using QGIS. For each species we measured its' geographic distribution as the total extent across Canada, based on a 20 km2 grid of collection sites.

Caterpillar DB varies considerably among species within the family of Geometridae, with the average species consuming 5.4 different tree genera (0.41 SE) throughout its range. The most generalized species, Ectropis crepuscularia, was recorded from a total of 17 different genera, whereas 10% of species were specialists that fed on a single genus. A species geographic distribution size is positively correlated with diet taxonomic richness (P = 0.0001) and phylogenetic diversity (P = 0.001). So the caterpillar species with a broader geographic range are able to feed on more tree genera. Moreover, we find that diet MPD was marginally related to geographic range (P = 0.08).

Natural Sciences and Mathematics

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ABSTRACT

Hurwitz Actions on Reflection Factorizations in Complex Reflection Group G_6

We show that in the complex reflection group G_6, reflection factorizations of a Coxeter element that have the same length and multiset of conjugacy classes are in the same Hurwitz orbit. This confirms one case of a conjecture of Lewis and Reiner.

Natural Sciences and Mathematics

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ABSTRACT

Making Connections: An Analysis of US Commercial Aviation Networks

Commercial aviation is a critical enabler in our 21st century service-based economy, facilitating the fast and reliable movement of people across the world. In the continental US, commercial aviation is at the crux of tourism, consumerism, and the economy as a whole. Our team conducted a technical network analysis of commercial air traffic in the continental United States through 2018. The data was obtained from the Bureau of Transportation Statistics, which gathers detailed information from all commercial aviation in the US.

The domestic commercial airline industry, dominated by the major carriers Southwest, United, American, and Delta, have over the decades developed their own interconnected "hub-and-spoke" models to connect airports across the US. Our team analyzed:

1) The national commercial aviation network
2) The differences between individual carrier networks, compared to both each other and random (null) networks
3) The changes to the commercial aviation network and individual carrier networks over time

Of particular interest is the analysis of overly taxed or fragile nodes across the different networks and time. Verma (et. al 2014) found that The World Airline Network (WAN) is a redundant and resilient system, yet it completely breaks down with the removal of seemingly insignificant and short connections. To expand upon these findings, we determined whether there are similar patterns and structures in the US Domestic Airline Network.

To organize, parse, study, and visualize our networks, we primarily used the R programming language through R Studio software, including the iGraph and ggplot2 packages. Notably, we examined core network measures such as degree, centrality, and betweenness for both the overall commercial aviation network, as well as each individual carrier network. The results of this study can be applied more broadly to better understand the current stability or potential future growth of commercial aviation, as it affects nearly all US economic sectors. Understanding systematic weaknesses can help governments better plan future policies or businesses to identify future investment opportunities.

Natural Sciences and Mathematics

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ABSTRACT

Primate Bone Microstructural Diversity and Growth Patterns

A unique feature of human life history is our pattern of slow body size growth during childhood followed by an acceleration of growth rate during adolescence. The presence of fast-depositing fibro-lamellar bone formation during infancy and adolescence, and its absence during childhood, was argued to be a possible marker of this strategy that could be potentially investigated in paleontological contexts. However, there are few comparative data on bone microanatomy from our closest living relatives, great apes, to understand whether this pattern is truly unique to humans. We examined patterns of primary bone microstructural development of the midshaft femur in wild representatives of two African great apes, Pan troglodytes (common chimpanzees; N=12) and Gorilla beringei beringei (Virunga mountain gorillas; N=15) and one lesser ape Hylobates lar (gibbons; N=28). It is known from previous studies that despite their larger body size, Virunga mountain gorillas have earlier ages at weaning, faster reproductive rates, earlier age at first birth, and earlier age at adult body size compared to wild chimpanzees. This is in line with the predictions of the Ecological Risk Aversion Hypothesis, which posits an association between increased frugivory (as in chimpanzees) and slower growth rates to reduce metabolic risks during the juvenile period. Accordingly, we predict that mountain gorillas will show increased proportions of fibro-lamellar bone compared to similarly aged chimpanzees. In 100-micron histologic sections, we quantified the percentage of primary periosteal cortical area (%CA) represented by different tissue types, which are understood to vary in accordance with bone depositional rate. Individuals were grouped into six age categories based on dental emergence and skeletal fusion (Partial DECID, DECID, M1, M2, M3, and EPIPH) for comparisons within and among species. A principal component analysis (PCA) was conducted to summarize variance within the dataset, and reveal species patterns of primary bone tissue type proportions. Results indicate that mountain gorillas are characterized by higher %CA of fibro-lamellar bone compared to chimpanzees during PDECID-M1 dental stages. In the M2 and older dental stages, both species show increased lamellar bone deposition, indicative of slower depositional rates. Our results suggest that primary bone microanatomical development in great apes is distinct from the pattern observed in humans, and may also reveal more subtle species differences in developmental life histories. This provides a promising avenue for life history investigations in the human and nonhuman primate fossil record.

Natural Sciences and Mathematics

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ABSTRACT

Computability Theoretic Complexity of Properties of Magmas

We investigate computability-theoretic complexity of determining whether an algebraic structure has a certain property, relative to the algorithmic description that presents a structure. We study computable structures, but also, taking examples from algebraic categories, consider structures admitting a recursive presentation in terms of generators and relators. We establish that certain properties (such as Markov properties) are hard in a given class of structures. We can apply general results to various specific structures including various magmas such as semigroups, racks and quandles.

Natural Sciences and Mathematics

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ABSTRACT

Dopamine Receptor Methylation is Correlated with Aspects of Chimpanzee Personality

Personality (i.e. behavioral tendencies or styles) is generally considered a stable trait in primates. Individual variation in the dimensions that make up personality exists in humans and their close relatives, chimpanzees. Recent research has found that patterns of DNA methylation are sometimes associated with these personality dimensions, suggesting that they may be influenced by environmental factors, such as rearing. The purpose of this study was to examine whether epigenetic modifications might be associated with personality dimensions in chimpanzees. Personality was measured and validated along the dimensions Reactivity, Extraversion, Dominance, Openness, and Agreeableness for 99 chimpanzees at Keeling Center for Comparative Medicine and Research, UT MD Anderson Cancer Center, Bastrop, TX. Peripheral whole blood samples were extracted from 53 of these chimpanzees and used to measure genome-wide methylation levels from microarrays. We examined the amount of CpG methylation at sites associated with eight behavior-related candidate genes: OXTR, AVPRIa, HTR1A, SLC6A4, DRD2, DRD4, NR3C1, and BDNF. The results suggest a strong association between methylation of the DRD2 gene, which codes for a key dopamine receptor, and the personality dimension of Extraversion (p corrected=0.021), as well as a lesser association with the dimension of Openness (p corrected=0.059). Variants in DRD2 have been associated with exploratory and sensation-seeking behavioral tendencies in humans, which are consistent with the chimpanzee personality dimensions of Extraversion and Openness.

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ABSTRACT

Framing Changes of Links in 3-Manifolds

Extending the work of McCullough and Chernov, the conditions under which the framing of a link can be changed via ambient isotopy are examined. A change in framing can only be accomplished via the Dirac trick in a manifold with a properly embedded non-separating S^2. Due to the invariance of spin structure and the parallelizability of every compact oriented 3-manifold the framing of a knot can only change by an even power.

Natural Sciences and Mathematics

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ABSTRACT

Applying Machine Learning to Radio Transient Searches

Radio transients are related to some of the most catastrophic events in the Universe, and being able to correctly identify them can teach about physics in the most extreme environments. A transient source is one that has a change in its brightness in a short amount of time. Searching for transients is one of the main scientific objectives of the VLA Low-band Ionosphere and Transient Experiment (VLITE) instrument on the Very Large Array (VLA). VLITE radio images are run through the Transient Pipeline (TraP) in order to build up light curves of the brightness changes as a function of time, and calculate different variability metrics that point to transient candidates. The process of checking transient candidates can be made more streamlined and less biased using machine learning on the variability metrics. This poster presents results from applying supervised machine learning algorithms on large VLITE data sets containing simulated sources, based on similar techniques developed for Low Frequency Array (LOFAR) transient searches. Training data sets of images with real stable sources and injected transient sources are used to create light curves in TraP and calculate their variability metrics. Then, using an anomaly detection method, the algorithm is trained to determine which combinations of variability metrics values indicate the most reliable transient candidates from real data sets. This process will enable a less biased, and more efficient and statistically accurate search for transient candidates.

Natural Sciences and Mathematics

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ABSTRACT

North Slope of Alaska Temperature Monitoring: Impacts of Vegetation Differences on the Permafrost System

This analysis examines the impacts of different land covers on the Northern Alaskan tundra soil-surface thermal regime as well as active layer thickness using historical Circumpolar Active Layer Monitoring (CALM) data collected over the 25-year period from 1995 to 2019. The CALM network comprises the active layer and near-surface permafrost monitoring component of the Global Terrestrial Network on Permafrost (GTN-P). North of the Brooks Mountain Range along the Dalton Highway, a transect of eight 1 ha sites were established in 1995 as part of the United States National Science Foundation's "Flux Study" that encompasses diverse landscapes on a north-south climatic gradient. At each site, there is continuous monitoring of air temperature at a 2 m height and spatially distributed soil-surface temperatures, as well as annual (in August) thaw depth measurements along three transects. Air and soil-surface temperatures are continuously monitored using 2-channel Onset Hobo Pro V2 temperature data loggers. Thaw depth is measured at 5 m intervals along the three transects in each plot by manual probing. Distinct differences have been observed in air and soil-surface temperatures within different land covers represented by these plots. Temporal assessments of temperature and thaw depth trends are used to characterize how these factors are changing through time. This study of the thermal impacts of vegetation and how these characteristics and relationships are changing given the warming climate can further contribute to our understanding of "Arctic greening." This phenomenon involves the thickening of herbaceous species and the northward encroachment of larger woody species into tundra environments, given warmer and longer growing seasons. These changes in vegetation height and community composition can result in both positive and negative thermal feedbacks for the permafrost system. Data presented in this work are available through either the CALM website (www2.gwu.edu/~calm/) or through GTN-P and can be used to validate regional to global scale permafrost models.

Natural Sciences and Mathematics

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ABSTRACT

CRISPR/Cas9 Editing of the Hox Gene Ultrabithorax Causes a Homeotic Shift in Wing Scales of Butterflies and Moths

The origin and evolution of Hox genes was a major event in the evolution of animal body plans. These genes demarcate relative positions in the embryo and their expression in a certain domain triggers a domain-specific signal cascade that mediates morphogenesis. Ultrabithorax (Ubx) is a Hox gene that specifies the hindwing identity in Lepidoptera (moths and butterflies). Using the gene-editing technique CRISPR/Cas9, we show that a loss of Ubx causes hindwing scales to take a forewing-like identity, thus suggesting that during the course of evolution, Ubx was deployed to the hindwing developmental network to generate differences between the forewing and the hindwing.

Natural Sciences and Mathematics

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ABSTRACT

Alcohol to Hydrocarbon Fuel via Catalytic Alcohol Coupling

The movement towards sustainable fuels derived from biofuels, which are net carbon neutral, is critical in order to decrease the emission of greenhouse gases and combat climate change. The ability to convert alcohols, like ethanol and butanol, into fuels has already been put into practice. Converting longer chain alcohols into hydrocarbon fuels is the next step towards renewable fuel. Here we present a two-step process for the formation of alkenes and alkanes from alcohols and aldehydes using low-cost supported heterogeneous catalysts. The reaction proceeds through dehydrogenation, aldol coupling and subsequent decarbonylation. The selectivity of the reaction can be tuned by changing the composition of the catalyst and or support.

Natural Sciences and Mathematics

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ABSTRACT

Synthesis of Catalysts to Grow Single Walled Carbon Nanotubes

Carbon nanotubes (CNTs) are of interest in the field of quantum computing. First, CNTs are excellent conductors. Also, they can be functionalized with a wide array of molecules, in particular quantum bit candidates, making them prime targets for molecular device integration. Chemical vapor deposition (CVD) one way to make carbon nanotubes, using a carbon-containing feedstock (typically methane) and dihydrogen passed at high temperature over a patterned catalyst. In order to control the structure and remove variability between the different types (diameter, chirality) of carbon nanotubes that can be obtained by CVD, a careful choice of the catalyst is necessary. The catalyst sites act as a cap from which the CNTs grow off of. Following a report by Li and coworkers (F. Yang et al, Nature, 2014, 510, 522), we decided to use the cobalt-containing polyoxometalate $Na_{15}[Na_3\{Co(H_2O)_4\}_6\{WO(H_2O)\}_3(P_2W_{12}O_{48})_3].nH_2O$ as catalyst. This phosphotungstate forms a triangular molecule (P_6W_{39} framework) with a $\{Co_6\}$ core. The synthesis of the catalyst is as follows (cf. Figure): we first prepare $K_6[P_2W_{18}O_{62}]$ from sodium tungstate and phosphoric acid. The $K_6[P_2W_{18}O_{62}]$ is then partially degraded in basic conditions, creating the hexalacunary structure $[H_2P_2W_{12}O_{48}]^{12-}$. Finally, three of the latter species are assembled with additional tungsten "hinges" around a cobalt core to yield the final product.

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ABSTRACT

In Silico-Guided Design of Environmentally-Benign Ionic Liquids for Biomass Processing

Over 90% of materials feedstocks are derived from oil and gas. However, due to depletion of natural resources, increasing greenhouse emissions and awareness of the need for sustainable development, transformation of biomass to valuable materials and energy (i.e. valorization) has emerged as a preferred alternative. Developing 'green' processes for biomass valorization has been a critical challenge in sustainable development, hindered by cost, biodegradability and toxicity concerns. Here, our goal was to develop functional and environmentally-benign methods for the deconstruction of cellulose in biomass feedstocks. Specifically, we aimed to inform the design of novel ionic liquids that meet the criteria for 'green' cellulose processing using an integrated in-silico-in-chemico approach. Ionic liquids, salts that are liquid at or near room temperature, have unique properties that enhance their ability to solvate the complex structure of cellulose by disrupting the vast network of hydrogen bonding. Imidazolium-based ionic liquids, specifically, have the ability to hydrolyze cellulose into glucose monomers. To that end, we relied on density functional theory to gauge the thermodynamics of the imidazolium decarboxylation reaction for a series of analogs, and computed the kinetic and thermodynamic propensity of the generated free carbene to cleave ether bonds in cellulose. Calculations were experimentally validated. By considering a series of imidazolium analogs in various solvents, and by integrating the Rule of Three, which is used to assess ecotoxicity of industrial chemicals in the design process, we outlined a design framework to guide development of novel, environmentally-benign ionic liquids for cellulose processing.

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ABSTRACT

Detection of Low Frequent SNP Variants for Enhancing Human Identification Capabilities

Microhaplotypes (MHs) are loci containing at least two SNPs associated in three or more allelic combinations within 300bp1. These biomarkers have small amplicons, ancestry informative alleles, no stutter, and lower mutation rate than short tandem repeats (STRs), which make them useful for human identification (HID), mixture deconvolution, and ancestry inference2,3. Sanger sequencing does not provide the cis/trans relationship between individual SNP alleles while massively parallel sequencing (MPS) allows distinguishing the parental haplotypes by clonal sequencing of individual DNA strand. The detection of low frequency ('rare') SNP variants can potentially increase the discrimination power of MHs and the ability to infer the number of mixture contributors. In this study we explored the potential of a newly developed pipeline to identify rare SNP variants within MH alleles and their impact on HID.

DNA samples from a large set of global population were selected and genotyped using a novel MPS multiplex panel of 74 MHs implemented on the Ion S5™ system3,4. Sequencing data were processed using the TVC Microhaplotyper plugin v8.1 (Thermo Fisher Scientific). To expand the potential of MHs to HID, a custom bioinformatics pipeline was developed (Microhaplotyper_CR_v1.0), which uses an alignment-specific tool to detect SNP defining the MH loci while identifying additional SNP variants present in between the SNPs that define the locus. The output file identifies the alleles based on the SNPs that define the locus and also other variants present within the amplicon. The frequencies of the additional SNPs of interest were checked in dbSNP database (https://www.ncbi.nlm.nih.gov/snp/) and frequency data under 10% cut-off reported for all population samples tested.

A total of 91 DNA samples from 4 US population groups (African, East Asian, European, and South Asians) were analyzed. In this preliminary analysis, 37 new SNP variants were reported across 30 different loci. All novel SNP variants have a frequency of <10% in the population of interest; however, 28 of them have frequency of ≤ 5% and 15 of them of ≤1%. Comprehensive analyses on >600 individuals from 14 global populations are ongoing to identify additional rare SNP variants.

Our preliminary findings suggest that rare SNP variants within the targeted MH regions can be identified. Detecting these variants will increase the discrimination power of an MH profile and also mixture deconvolution capabilities of this MH assay.

Natural Sciences and Mathematics

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ABSTRACT

Physical Morphologies of Paleosols in the Context of Pedogenic Carbonate Analysis

Hominin ancestors and their adaptive regimes through time have been molded by the environments within which they inhabited. Studying the paleosols, preserved ancient soils, that have persisted from those environments is crucial to understanding the context which hominins existed and evolved in. Previous studies have offered extensive information on paleosol data from over the Turkana Basin and have included morphological descriptions in tandem with isotopic data. Carbon-13 and oxygen-18 isotopic data from these paleosols indicate the relative wetness or dryness of an environment during a given period of time, as well as its vegetative cover; this information has been synthesized to indicate how East African Rift Valley, especially during the Plio-Pleistocene epochs from 5.33 to .012 million years ago, was a mosaic of environmental conditions that influenced early hominins. This study seeks to compare the morphological descriptions of paleosols using a procedure from the 2015 field school that grades observations on a scale of 1 to 5; in this study, we seek correlations of these grades to carbon and oxygen data.

In the 2019 field season, we collected 20 new paleosol samples from the KBS and Okote Members of the Koobi Fora Formation for future processing in the lab, and used data from the 2015 field season for our assessment. Each paleosol sample was described to certain degrees of presence or absence of 22 identified notable morphological features, such as location, stratigraphic member, calcium carbonate nodule size, slickenside grade, and reactivity when exposed to hydrochloric acid. Each of these physiological features was then statistically compared to their isotopic signatures.

Our statistical analyses using the Kruskal-Wallis model and Generalized Linear models indicated a positive correlation with carbon isotopes within a 95% confidence interval for the slickenside structure, carbonate nodule shape, area, primary stage, and ped size, respectively. This information is useful for filling a gap in paleogeological studies, which lack uniform procedure for describing paleosols in their data. This study recognizes a potential bias in its results due to a smaller sample size; future studies should incorporate more samples and create a visual guideline for grading each morphology.

Natural Sciences and Mathematics

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ABSTRACT

The Relationship Between Thermal Tolerance and Evolution of Setae in the Turtle Ants (Cephalotes)

The formation of the seasonally dry cerrado in Brazil has presented ecological opportunity to species previously adapted to wet forest, but species transitioning to this biome experience increased exposure to insolation and greater heat stress. This biome also includes high heterogeneity in thermal microhabitat, ranging from canopy-covered gallery forest to exposed grassland. Species of the ant genus Cephalotes are found throughout the Neotropics and reach high species richness in cerrado. Additionally, these ants exhibit high morphological diversity in setae covering the cuticle, which are often scale-like and highly reflective. Here, I investigate the role of thermal environment and sun exposure in shaping the evolution of this highly variable trait. The functional capacity of setae to deflect heat was determined for four co-occurring species by measuring internal body temperature of focal species with natural setae cover and with setae removed by forceps before and after exposure to a halogen lamp. Thermal environment of trees inhabited by each focal species was characterized by measuring tree surface temperature each 0.5 m along branches in the foraging range of a colony. For a broader phylogenetic sample of species, percent cuticle coverage on the dorsal surface of each major body segment was determined using carefully oriented images and the ImageJ particle analysis function. These measurements were analyzed across the genus Cephalotes with phylogenetic comparative tools, comparing setae cover evolution of species in dry or seasonally dry biomes to those in wet forest. Setae removal experiments indicate that setae provide a buffering of internal body temperature against increased sun exposure. Phylogenetic comparative analyses across the genus suggest a high lability of setae cover within Cephalotes species distributed throughout cerrado. These results suggest a link between the evolution of setae cover, thermal buffering of internal body temperature, and thermal microhabitat of preferred nesting locations in Cephalotes species. This ongoing research will contribute to understanding the role of shifts in abiotic conditions, often associated with major biome transitions, in the evolution of adaptive thermal traits.

Natural Sciences and Mathematics

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ABSTRACT

Replacing Limestone with Natural "Green" Aggregates to Increase the Compressive Strength of Concrete

Concrete is among the most highly utilized materials in the world. It is essential for building common structures such as roads, bridges, buildings, etc. However, the cost of producing concrete has been rapidly rising due to the lack of eco-friendly and abundant resources. The growing demand of concrete is analogous to the increasing price of limestone, which is the main aggregate used in the production of concrete. An aggregate is a granular material that is used to hold the concrete mixture together. The process of producing concrete has also been known to cause many harmful environmental effects. Concrete made with limestone requires machinery to heat and crush it in order to decrease particle size, and the process of heating the limestone, referred to as calcination, is a significant producer of carbon dioxide. Therefore, the substitution of limestone with natural aggregates such as coconut fiber, rice husks, seashells, and eggshells could potentially create more durable and abundant concrete that can be obtained at a lower cost. These materials are currently improperly disposed of as waste but contain fiber that allows them to act as effective aggregates in concrete. The experiment tested the compressive strength of a concrete composition with the natural raw materials as aggregates. Concrete samples with limestone as the aggregate served as the control group. Compressive strength, measured in units of Pascals, is a critical component when examining workability and durability of a concrete structure and is defined as the resistance of concrete under compression.

Ten concrete cylinder samples were made per group and allowed to cure for 7 days. A compressive strength testing machine was used to measure the compressive strength of each cylinder. Statistical analysis using an ANOVA test showed that the concrete samples with the greatest compressive strength had been constructed with coconut fiber as the aggregate, although the values did not exceed that of the control. Future research could be focused towards finding more eco-friendly aggregates that produce lighter concrete in order to lower albedo, which is radiation reflected by a surface. The aggregate substitutes could also be utilized to develop concrete that emits lower rates of carbon dioxide while being produced. Concrete with a high compressive strength that can be produced at low cost could be essential for areas affected by natural disasters that require attainable resources to repair buildings and homes and could also be used for low-income housing.

Natural Sciences and Mathematics

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RESEARCH MENTOR/DEPARTMENT CHAIR

Ioannis Eleftherianos

ABSTRACT

Interaction Between the TGF-β Ssignaling Pathway and Drosophila Carbohydrate Metabolism

Drosophila melanogaster is an excellent model organism to study metabolic processes due to its ease of culture, genetic accessibility, and well conserved pathways such as the Transforming Growth Factor-β (TGF-β) signaling pathway. Recently, the two signaling branches of the TGF-β signaling pathway, Activin and Bone Morphogenetic Protein (BMP), have been shown to participate in the D. melanogaster metabolic response to infection with the parasitic nematode, Heterorhabditis gerrardi. In this study, we used H. bacteriophora which belongs to the same genus as H gerrardi. To investigate the effects of the nematode infection without assistance from its symbiont we generated and used axenic (lacking P. luminescens) nematodes. Our aim was to investigate the interaction between the TGF-β signaling pathway and D. melanogaster carbohydrate metabolism upon axenic (lacking Photorhabdus luminescens bacteria) or symbiotic (containing P. luminescens) H. bacteriophora infection. To interfere with TGF-β signaling activity, we used D. melanogaster larvae carrying loss-of-function mutations in the genes coding for the Daw (Activin signaling) and Dpp (BMP signaling) extracellular ligands as well as their background controls. To quantify trehalose, glucose, and glycogen levels in D. melanogaster larvae, we used plate reader-based assays. We found elevated trehalose levels in background control larvae infected with symbiotic nematodes compared to uninfected individuals. Also, dpp mutant larvae infected with symbiotic H. bacteriophora had significantly higher trehalose levels than those infected with axenic nematodes. However, trehalose levels were significantly lower in daw mutant larvae infected with symbiotic nematodes compared to uninfected controls. Daw mutant larvae also contained higher trehalose and lower glucose levels compared to background controls in the presence or absence of infection. Daw mutants further displayed increased glucose concentration upon infection with symbiotic nematodes compared to uninfected larvae. Finally, there was no significant change in the amount of glycogen in neither the mutants nor the control larvae for any of the treatments. Overall, these findings suggest that the TGF-β signaling pathway might regulate D. melanogaster sugar metabolism in response to parasitic nematode infection. Results obtained from this and other similar studies might contribute towards the development of novel treatment strategies for combating parasitic nematode infections in humans.

Natural Sciences and Mathematics

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ABSTRACT

Morphological Characterization of Convergent Metallic Color in Lepidoptera

In nature, metallic golds and silvers — from the shimmer of fish skin to the gleam of jewel scarabs — are produced not by pigments, but by microscopic optical structures. Metallic coloration requires the reflectance of many wavelengths, or broadband reflectance, which is typically generated by the layering of optical structures. As a result, a relatively thick layer on the order of hundreds of microns is required.

Butterfly wings exhibit a dazzling array of colors, including golds and silvers; however, they are confined by the scale, their fundamental unit of color, which is only a few microns thick. Instead of vertical stacking of layers, the optical structures are oriented horizontally such that broadband reflectance is generated by spatial color mixing across the scale — creating an ultrathin reflector. Butterflies make use of a wide variety of strategies to create silver and gold; here we examine 8 species across all butterfly families that display metallic colors. Reflected-light microscopy, microspectrophotometry, cryofracture and scanning electron microscopy of single scales reveal unique mechanisms of spatial color mixing and structures underlying these ultrathin reflectors.

Natural Sciences and Mathematics

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ABSTRACT

The Gut Microbiome of Northern Australian Termites

As some of the world's most effective decomposers, termites and their gut microbial symbionts can break down wood, grass, litter, soil, and other complex compounds. However, when most people think of termites, they think only of the pest species that break down wood in human homes, which comprise only 1/30 of termite diversity. Of the abundance of termite gut microbiome research looking at the relationship between these termites, their symbionts and decomposition, the majority have focused on the microbial communities of a few pest species and ignored the wealth of information that can be gleaned by looking at the gut microbiome of other termite guilds such as grass-feeders and litter-feeders. Additionally, to date, most termite gut microbiome studies have used 16S amplicon method, which economically reveals the bacterial species present in a community, but overlooks any eukaryotic organisms present in a sample, and sometimes presents bias. In this study, we compare the 16S amplicon method with its counterpart whole metagenomic shotgun (WMS) sequencing, which allows us to take a snapshot of all microbes present in termite guts from different feeding guilds. We contrast the alpha, beta and gamma diversity portrayed by these two methods and evaluate two common microbial DNA extraction kits commonly used for termite gut microbiome studies. We analyze the community differences in two grass-feeding and two wood-feeding species of termites and highlight key similarities and differences in taxa between the two guilds. With the advances in microbiome analysis techniques, it is important to gain an understanding of the bias that comes attached to each method, and this project is key to realizing what is missing or overabundant in these types of studies.

Natural Sciences and Mathematics

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ABSTRACT

Replacing Limestone with Natural "Green" Aggregates to Increase the Compressive Strength of Concrete

Concrete is among the most highly utilized materials in the world. It is essential for building common structures such as roads, bridges, buildings, etc. However, the cost of producing concrete has been rapidly rising due to the lack of eco-friendly and abundant resources. The growing demand of concrete is analogous to the increasing price of limestone, which is the main aggregate used in the production of concrete. An aggregate is a granular material that is used to hold the concrete mixture together. The process of producing concrete has also been known to cause many harmful environmental effects. Concrete made with limestone requires machinery to heat and crush it in order to decrease particle size, and the process of heating the limestone, referred to as calcination, is a significant producer of carbon dioxide. Therefore, the substitution of limestone with natural aggregates such as coconut fiber, rice husks, seashells, and eggshells could potentially create more durable and abundant concrete that can be obtained at a lower cost. These materials are currently improperly disposed of as waste but contain fiber that allows them to act as effective aggregates in concrete. The experiment tested the compressive strength of a concrete composition with the natural raw materials as aggregates. Concrete samples with limestone as the aggregate served as the control group. Compressive strength, measured in units of Pascals, is a critical component when examining workability and durability of a concrete structure and is defined as the resistance of concrete under compression.

Ten concrete cylinder samples were made per group and allowed to cure for 7 days. A compressive strength testing machine was used to measure the compressive strength of each cylinder. Statistical analysis using an ANOVA test showed that the concrete samples with the greatest compressive strength had been constructed with coconut fiber as the aggregate, although the values did not exceed that of the control. Future research could be focused towards finding more eco-friendly aggregates that produce lighter concrete in order to lower albedo, which is radiation reflected by a surface. The aggregate substitutes could also be utilized to develop concrete that emits lower rates of carbon dioxide while being produced. Concrete with a high compressive strength that can be produced at low cost could be essential for areas affected by natural disasters that require attainable resources to repair buildings and homes and could also be used for low-income housing.

Natural Sciences and Mathematics

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Igor Strakovsky

ABSTRACT

Application of Machine Learning to π0 Photoproduction

Confirming the existence of elementary particles and their excited states requires extremely precise measurements of energies released in collisions between composite particles. π0 photoproduction can be achieved by blasting protons, polarized in a butanol (C_4H_9OH) targets, with photons of 0.4 – 2.4 GeV. Protons in these targets were polarized via the Dynamical Nuclear Polarization technique. However, this does not eliminate bound-nucleon reactions, which then necessitates the target of interest in this experiment. In measurements done at the CLAS detector in Hall B at the Thomas Jefferson National Accelerator Facility, carbon targets were added downstream of the butanol to then subtract the background from bound-nucleon reactions.

The cooling system used to for the carbon targets was defective and developed patches of ice, which then produced erroneous data in what was collected. Traditional methods of correcting this type issue involve throwing away large swaths of expensive data. Instead, implementing machine learning may present a viable solution without the cost of wasted data production. We developed a neural network using TensorFlow in Python that analyzed the data collected and identified which hits were associated with carbon, butanol, or polyethylene.

Once the carbon hits were extracted, it was then possible to identify training data for ice by comparing the energy distributions of the carbon and butanol. These should be relatively similar with only a multiplicative difference in magnitude, but the ice creates an irregular spike in the carbon energies. Finally, using known ice and carbon hits, it was possible to develop a second neural network that parsed the ice and carbon data. Access to training data is extremely limited, which is why we were forced to use sections of data from the experiment to train the neural network. This is not an illegitimate strategy but is difficult to balance, as using too much of the same data can lead to overtraining and overspecialization. Nevertheless, we were successful in developing this as a proof of concept to show that this technology has strong potential for implementation in nuclear experiments.

Natural Sciences and Mathematics

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Erik Rodriguez

ABSTRACT

Chemical Tools for Fluorescence Imaging and Treatment of Cancer

One in three Americans will develop cancer in their lifetime and ~60% is caused by random genetic mutations. Antimitotic drugs prevent cell division and are often used to treat cancers, but are prone to resistance. Published fluorescent cell cycle indicators often lack detailed division of sub-mitotic phases. Lamin B1, a nuclear membrane protein, exhibits distinct morphologies between mitotic phases and gives distinct information about cellular division. We have tagged the small ultra-red fluorescent protein to human Lamin B1, and I have validated nuclear membrane morphology alignment with mitotic phase to develop a fluorescent cell cycle indicator for precise identification of mitotic phase to improve high throughput drug screening for personalized medicine and drug development. Another form of cancer treatment, photodynamic therapy, uses a photosensitizing, reactive oxygen generating molecule to kill cells upon irradiation by specific wavelengths of light. Reactive oxygen generating small molecules have poor solubility in biologically compatible solvents, while proteins and hybrid systems fail to be excited or fluoresce in the far-red for optimum tissue penetration for therapeutic purposes. The small ultra-red fluorescent protein fluoresces at 670 nm and utilizes an exogenous chromophore, biliverdin. Mammals produce 500 mg of biliverdin, a highly aromatic tetrapyrrole, per day and is responsible for the green color of bruises. Halogenating biliverdin, through bromine addition, increases reactive oxygen species production after covalent attachment to the small ultra-red fluorescent protein and exposure to light. I synthesized a brominated biliverdin analog and confirmed attachment between the analog and the small ultra-red fluorescent protein to create a reactive oxygen generator for fluorescence guided surgery and light activated cell death of individual cancer cells left post-operation. Novel chemical tools enable a new era of cancer treatment using personalized medicine to image the cell cycle of excised patient cancer cells for optimal drug(s) treatment determination and reactive oxygen generators for fluorescence guided surgery and post-operative photodynamic therapy to kill remaining cancer cells to avoid relapse.

Natural Sciences and Mathematics

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ABSTRACT

Impact of Sublethal N-(phosphonomethyl)glycine) on Honey Bee (Apis mellifera) Memory Retention

Honey bees (Apis mellifera) are major pollinators of important economical value, contributing over $20 billion from pollination services. After almost 15 years, Colony Collapse Disorder (CCD) is still a phenomenon with unknown causes in which the worker bees rapidly abandon their hive, leaving behind the brood, honey, and the queen. Recent research has focused on fungi, parasites, and pesticides as potential causes of CCD. This study investigates the effects of sub-lethal doses of glyphosate (10 ng glyphosate/ 5 µL of sugar water), the active ingredient of the herbicide Round-Up. Using the proboscis extension reflex, we used classical conditioning protocols to train honeybees to recognize a scent (conditioned stimulus), initially associated with a light anntenal touch of a swab soaked with sugar water (unconditioned stimulus). Subsequently, honeybees were divided into a treatment group fed 5 uL of 2.05×10-6 mg of glyphosate/ mL of sugar water and a control group fed 5 uL of 2:1 ratio sugar water. We tested bees' memory retention in both groups by measuring how successful we were to illicit PER. We found that the honey bees treated with glyphosate had a significantly lower success rate of 23%, compared to the control group's success rate of 49.7%. In a second study, we investigated the effect of sublethal doses of glyphosate on the spatial memory of honeybees training them on a path in a maze by classical conditioning. When subsequently we tested for memory retention, bees treated with sub-lethal doses of glyphosate had a higher rate of incorrect maze turns compared to control bees. In addition, anecdotal evidence showed treatment bees behaving in a very unnatural manner, buzz-flying through the maze compared to walking in control bees. Future studies will focus on the cognitive effects of sublethal doses of additional pesticide classes.

Natural Sciences and Mathematics

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ABSTRACT

Effects of Kayak and Center Divider Knockdown on Male Sperm Length in Drosophila Melanogaster

Males of Drosophila have been found to produce some of the longest known sperm, measuring up to 5.83 cm in D. bifurca. Because Drosophila females mate with multiple males, sperm must compete within the female reproductive tract in the process of post-copulatory sexual selection. Males with long sperm have been found to experience greater mating success than males with short sperm in females with long sperm storage organs, or seminal receptacles (SRs). Furthermore, there is a significant genetic correlation between sperm length and SR length. These results suggest that the two reproductive traits are coevolving and may be under the influence of pleiotropy. The genes kayak and center divider (cdi) have been previously identified through QTL mapping as candidate genes that may influence sperm length in Drosophila. The kayak gene encodes a transcription factor that is involved in many processes including embryonic development, wound healing, and cell polarity while cdi is present in the sperm proteome and expressed during spermatogenesis. Previous studies have found that knockdown of each gene results in increased SR length in Drosophila females, but have not been able to observe the effect of knockdown on sperm length in males. The goal of this study was to identify the influence of genetic knockdown of kayak and cdi on sperm phenotype. Because the knockdown of each gene resulted in increased SR length, we expect that knockdown will result in increased sperm length as well. The pleiotropic influence of kayak and cdi on both SR length and sperm length will identify them as candidate genes for the molecular mechanism of male-female Drosophila coevolution.

Natural Sciences and Mathematics

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Andrew Choi

ABSTRACT

Preventing Heart Attacks Before They Happen: A Case-Cohort Study of Atherosclerosis

Heart disease is the leading cause of death in the United States which has necessitated novel methodologies to detect and prevent its onset. Cardiac computed tomography angiography (CCTA) is a validated, non-invasive imaging approach that can identify accurately identify early coronary atherosclerosis, the precursor to heart attacks and sudden death. Recent research has enabled a better understanding of qualitatively defined high risk plaque features identified by CCTA. However, the prognostic data regarding the role of whole heart quantification of atherosclerosis is uncertain, particularly in those patients who have suffered heart events. Specifically, in patients with non-ST-elevated myocardial infarction (NSTEMI) coronary atherosclerotic burden is expected to be higher than in patients with stable coronary artery disease.

In this Institutional Review Board approved, ongoing retrospective case-control study, we aim to determine which plaque types are most apparent in individuals who experience cardiovascular events in order to better predict heart attacks before they happen. The patient cohort consists of patients from the George Washington University Hospital who have either established (case patients) heart attacks or control patients. Control group individuals have been selected based on medical reports citing acute chest pain, however, presented with negative troponins and no EKG changes. Both cohorts' cardiac CT scans with contrast will be analyzed using specialized plaque quantification software (Medis QAngio Suite, Leiden, Netherlands).

Through the comparison of plaque accumulation between subjects presenting with risk factors for coronary artery disease and having experienced NSTEMI matched by age, gender and traditional heart disease risk factors to control subjects, we further to identify the volume of established vulnerable plaque types (necrotic core, fibrous, fibrous-fatty, and calcified plaque) and plaque type burden (Figure). The identification and quantification of such plaque types between NSTEMI and Control groups may prove beneficial towards proactive intervention and prevention. In the future, we anticipate our findings to be further studied in a prospective manner to understand how non-invasive cardiac CT may direct strategies for preventive medical therapies.

Natural Sciences and Mathematics

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ABSTRACT

Radio Frequency Projects at GW

The GW physics department currently supports two radio engineering projects. The first is a tailored RF system provides a portable and low cost solution to urban Solar observations in the upper VHF band. The novel parabolic reflector enables the end-user to narrow the observation beamwidth, effectively reducing the need for active amplification and mitigating the impact of environmental RF interference. The second is an experimental VHF CubeSat antenna design that is integrated into the metal body rather than using a typical dipole or whip antenna. Specialty RF equipment and expertise had to be acquired in order to fulfill capability gaps. This equipment, paired with the foundation that these two projects set, can expand native RF research at GW.

Natural Sciences and Mathematics

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ABSTRACT

The Merger Environments of Short Gamma-Ray Bursts

The association of a host galaxy with a short gamma-ray burst (SGRB) depends on accurate localization of the SGRB. 20-30% of well-localized SGRBs lack a coincident host to deep optical and NIR limits. These SGRBs have been identified as observationally hostless due to their lack of strong host associations. Considering early time Swift observations of short GRB afterglows we derive lower limits on their circumburst densities. We calculate the gas density at the viral redshift of an average SGRB host galaxy and by adopting this threshold identify that $<16\%$ of our sample could have merged within such densities. We find that out of the five observationally hostless bursts in our sample, none are consistent with having occurred outside that radius. This implies one of two scenarios. Either the binary neutron stars leading to those SGRBs merged at a large enough offset from their birth galaxy that the probability of galaxy misidentification is large (but such that they still merged well within their host's galactic halo) or else these binaries merged in faint host galaxies at moderate to high redshifts that were missed by follow-up observations.

Natural Sciences and Mathematics

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Aleksandar Jeremic

ABSTRACT

High Resolution Microscopy Analysis of Amylin Turnover in Pancreatic Beta Cells

Human islet amyloid polypeptide (hIAPP) is a molecule cosecreted with insulin from pancreatic beta cells which plays a complex role in glucose regulation. In patients with Type Two Diabetes Mellitus (TTDM), human amylin can form toxic protein aggregates, leading to a loss of pancreatic beta-cell mass. The complete mechanism by which hIAPP is trafficked through and becomes toxic to cells has yet to be elucidated. Because hIAPP is a hormone, it should be processed through the cell's biosynthetic compartments, endoplasmic reticulum and golgi apparatus, before being excreted into the blood. However, transmission electron and confocal microscopy studies of rat insulinoma (INS) cells which express human amylin show that it may also be directed to other intracellular organelles, such as the mitochondria and the nucleus. To investigate the impact of human amylin in the mitochondria, we ran an MTT viability and metabolic assay. We found that overexpression and intracellular accumulation of hIAPP sensitizes these cells to ER stress evoked by thapsigargin, thus providing a regulatory link between ER stress and hIAPP evoked mitotoxicity. To further investigate amylin nuclear trafficking, we treated human pancreatic islet cells with thapsigargin, tunicamycin (both ER stress inducers) and high glucose conditions, and tracked the location of hIAPP using 3D confocal microscopy. We found that non-aggregated hIAPP accumulated in the nucleus and the nucleolus of cells. In future studies, we hope to elucidate the specific mechanism by which amylin translocates to the nucleus/nucleolus of cells, and investigate any toxic affect or functional role it has in these compartments. Elucidating amylin's mechanisms of trafficking and toxicity could lead to novel therapeutic interventions for patients with TTDM, as well as a greater understanding of how cells manage toxicity induced by misfolded proteins.

Natural Sciences and Mathematics

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RESEARCH MENTOR/DEPARTMENT CHAIR

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ABSTRACT

The Detection and Identification of Synthetic Cathinones by Portable Nano-Liquid Chromatography with Dual Wavelength Ultraviolet Detection

The portable liquid chromatograph instrument employed in this investigation is the first of its kind, weighing only seventeen pounds, it can easily be transported between the laboratory and the field. The instrument's software can be run on a laptop or tablet connected through built in Wi-Fi and has a rechargeable battery that can be used for 10 + hours. Because of its size, the instrument uses a fraction of the solvents and produces a fraction of the waste than conventional laboratory liquid chromatography (LC) systems. The portable-LC can be equipped with different tandem columns in series with on-column LED ultraviolet detection at two wavelengths. This instrument is well suited for the screening of seized drugs because it can give two uncorrelated retention times and peak area ratios that are proportional to the drug's extinction coefficient at both wavelengths. In addition, based on the multitude of identification points, it could meet SWG Drug guidelines for drug identification. The present study employs two capillary columns in series, e.g. C8 and biphenyl, and dual UV detectors, e.g. 255 nm and 275 nm for the screening and/or identification of different synthetic cathinones, including in the presence of adulterants. It was determined that 56% (9/16) of synthetic cathinones can be distinguished by a single relative retention time. The addition of the second column did not contribute much information, 69% (11/16) of synthetic cathinones can be distinguished by relative retention times of the two columns. With the addition of the peak area ratio, 100% (16/16) of synthetic cathinones can be distinguished by all three parameters. For the most part good repeatability of the relative retention times of both columns and the peak area ratios was observed. Due to low ppm limits of detection, and a range of at least an order of magnitude with good linearity (≥ 0.996), the portable LC is applicable for both qualitative and quantitative analysis. The instrument, with more uncorrelated columns, can be capable of providing two Category B tests and possibly a Category C test, thus fulfilling minimum SWGDrug requirements when a Category A test is unavailable. The investigated technology is both economically and environmentally friendly due to reduced solvent consumption and waste generation, and a relatively low acquisition cost.

Natural Sciences and Mathematics

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Xiangyun Qiu

ABSTRACT

Fractionation of DNA Length

Within the biophysics field, it is important to reduce the different aspects of variation as much as possible to isolate the effects on the data. One aspect researchers desire to keep consistent is DNA length. Synthetic DNA comes in a variety of different lengths of DNA in a solution. There requires a method to consistently fractionate the lengths of DNA from the solution. Polyethylene glycol (PEG) has the ability to precipitate proteins and nucleic acids from solutions, particularly DNA. When PEG is added to a DNA solution, there is a competition for solvent space between PEG and DNA. PEG can take the solvent space from DNA, which results in DNA condensing into its smaller form. Eventually, PEG will occupy all of the solvent space and force the DNA to precipitate out of the solution. Long pieces of DNA should be the first to precipitate out of the solution by PEG because it is more space-inefficient. However, there is a repulsive force -- because of the phosphate group in the DNA -- that must be accounted for by adding salt to the solution, thus shielding the repulsive force. With the correct amount of salt and PEG, the DNA precipitated should only consist of long DNA and the DNA solution should be fractionated. The ability to fractionate the DNA and with what length depends on the concentration of PEG, the amount of salt, and molecular weight of PEG. By varying these three factors and using gel electrolysis, this research determines the validity of this method to fractionate DNA length by PEG on the quantitative level.

Neuroscience

Institute for Biomedical Sciences (PhD Students in IBS Only)

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Robert Miller

ABSTRACT

CNS Specific B cell Ablation Reduces Disease Severity in an Animal Model of Multiple Sclerosis

Multiple sclerosis (MS) is an autoimmune, demyelinating disease of the central nervous system (CNS), characterized by myelin damage, infiltration of peripheral immune cells and severe functional deficits. Antibody-mediated peripheral B cell depletion therapies have been shown to significantly reduce the volume of MS lesions and formation of new lesions, suggesting a pathogenic role for B cells in MS. However, long-term systemic B cell depletion can severely immunocompromise the patient, and a better understanding of how B cells contribute to neurological dysfunction in MS is needed. In the current study, we aim to define the pathogenic role of CNS infiltrating B cells in MS by spatial depletion of CNS specific B cells. We utilized an inducible caspase 9 (iCP9) mouse with a CD19 promoter to selectively ablate CNS infiltrating B cells in mice induced with experimental autoimmune encephalomyelitis (EAE), an animal model for MS. We report that iCP9 activation in CD19+ B cells selectively ablated CNS B cells and did not affect peripheral B cells in the blood, lymph node, and spleen. Elimination of CNS specific B cells reduced Iba1+ microglial and GFAP+ astrocyte reactivity. This was associated with reduced myelin and axonal damage and functional impairment compared to control EAE animals. To determine if EAE B cells directly contribute to increased CNS glial cell reactivity, B cells were isolated from EAE animals and co-cultured with spinal cord glial cells. Glial cells stimulated with EAE B cells showed increased astrocyte and microglia reactivity compared to cells co-cultured with healthy B cells. This was associated with oligodendrocyte death and disrupted myelin sheaths. Our data suggest that CNS infiltrating B cells contribute to glial reactivity and myelin damage in EAE and as such provide novel insight into the underlying mechanism of MS pathology.

Neuroscience

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Robert Miller

ABSTRACT

Refinement of Axonal Function During Development of the Mouse Optic Nerve

The optic nerve is a white matter tract and in the adult, virtually all axons are myelinated. During mouse optic nerve development, myelination of these axons begins around postnatal day 7 and continues until the fifth week. While the nerve is considered morphologically stable beyond 5 weeks of age (wks), the relationship between nerve function and myelination during late-development has yet to be characterized.

This study evaluates optic nerve conduction and myelination patterns in C57BL6 mice (aged 4-12 wks) using ex vivo compound action potentials (CAPs) recordings of isolated optic nerves, immunohistochemistry, and scanning electron microscopy. The electrically-induced CAP waveforms represent the total number of responsive axons in a nerve and functionally-distinct axon populations (defined by peaks within the waveform). When compared across age groups (n>8), there was a significant increase in average CAP area between 4 and 5 wks (p=0.007) and between 6 and 8 wks (p=0.02). These two age groups corresponded with recruitment of intermediate- and fast-conducting axon populations, respectively. The slowest axon populations were present at ages 4-6 wks and lost at older ages (8 and 12 wks), when additional fast populations were recruited. These dynamic changes in optic nerve function after initial development indicate an additional period of refinement. To determine the relationship between these functional changes and myelination, nodal density and g-ratio distributions of the optic nerve were evaluated from 4-12 wks. Nodal density was not significantly different during late-development, suggesting that internode length may not be associated with age-related changes in nerve function. Ultrastructural analysis of optic nerves reveals shifts in g-ratio (myelination per axon) distributions across age groups, which are consistent with changes in nerve conduction. We conclude that refinement of optic nerve function during late-development may be associated with dynamic myelination patterns.

Neuroscience

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ABSTRACT

Visual Sequences Drive Experience-dependent Plasticity in Mouse Anterior Cingulate Cortex

Mechanisms of experience-dependent plasticity have been well characterized in mouse primary visual cortex (V1), including a form of potentiation driven by repeated presentations of a familiar visual sequence ("sequence plasticity"). The prefrontal anterior cingulate cortex (ACC) responds to visual stimuli, yet little is known about if and how visual experience modifies ACC circuits. We found that mouse ACC exhibits sequence plasticity, but the plasticity expresses as a change in response timing, rather than a change in response magnitude (as in V1). Sequence plasticity was absent in ACC, but not V1, in a mouse model of a neurodevelopmental disorder associated with intellectual disability and autism-like features. Our results demonstrate that simple sensory stimuli can be used to reveal how experience functionally (or dysfunctionally) modifies higher-order prefrontal circuits, and suggest a divergence in how ACC and V1 encode familiarity.

Neuroscience

Institute for Biomedical Sciences (PhD Students in IBS Only)

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Joshua Corbin

ABSTRACT

Sex Differences in Two Molecularly-Defined Medial Amygdala Neuronal Subpopulations

The medial amygdala (MeA) is implicated in processing social cues, including mating and aggression. It has previously been shown that the MeA has sexually dimorphic responses related to these social cues shown by different neuronal responses. Specifically, studies have shown that neurons from the male and female MeA have molecular and morphological differences. Determining the breadth of these molecular sex differences in the MeA is crucial to understanding sex differences in behavior. Our lab has previously identified two subclasses of MeA inhibitory output neurons by their expression of progenitor pool markers, transcription factors Developing Brain Homeobox 1 (Dbx1) or Forkhead Box P2 (Foxp2). Sex differences in the biophysical properties of these two distinct MeA populations were determined, in our lab, using electrophysiology. We wanted to identify ion channels responsible for the sex differences observed in the action potential spiking patterns of the Dbx1- and Foxp2- lineage neurons. In order to determine which specific channels are regulating the biophysical properties of these neurons, specific ion channels were chosen that have been shown to have sex differences in the MeA. Thus, using mouse models with GFP-expressing neurons, labeled based on their subclasses, ion channel candidates were validated using immunohistochemistry. Overall, ion channel composition may play a role in how the MeA differentially processes information from different populations of neurons in males and females

Neuroscience

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Paul Marvar

ABSTRACT

Transcriptomic Analysis of the Basolateral Amygdala (BLA) Following Post-Retrieval Losartan on Fear Memory

The renin angiotensin system (RAS) and its components have been implicated in fear memory, learning and behavior in both rodents and human with a growing body of evidence demonstrating the utility of angiotensin Receptor Blockers (ARBs) such as losartan in the treatment of maladaptive fear associated with posttraumatic stress disorder. Our lab has previously shown the role of angiotensin type 1 receptor (AT1R) blockade in extinction fear memory, however its role in the alternative memory process of reconsolidation remain unclear. We hypothesized that post-retrieval blockade of AT1R with losartan would disrupt reconsolidation and alter central transcriptomic pathways in the basolateral amygdala (BLA) - a crucial site for emotional learning.

We combined classic Pavlovian auditory fear conditioning with whole-genome RNA sequencing to evaluate the effect of peripherally administered losartan (10mg/kg; i.p) on short-term (STM) and long-term (LTM) fear memory tests and transcriptional level.

Male C57Bl/6 mice injected with peripheral losartan after memory retrieval showed a significant reduction in freezing behavior in comparison to saline controls during long-term memory testing at 24hrs ($F_{1, 17}$ = 5.739, p = 0.0284, n=12) and a trend for reduction during 1week ($F_{1, 19}$ = 2.282, p =0.1474, n=12). An increased expression (2-3 fold) of immediate early genes; Fos (p<0.008), Arc (p<0.0026) and Egr-1 (p<0.0001) was confirmed at 40mins in both the retrieval groups irrespective of the drug treatment. Using Illumina NextSeq series for RNA sequencing, at p<0.05 statistical cut off threshold, we identified 90 differentially expressed genes (DEGs) for saline and 38 DEGs for losartan relative to non-retrieval (NR) control group in BLA at the same time point. At this early timepoint, a large overlap of 23 common genes between the groups was observed and attributed to the behavioral intervention of fear memory consolidation. Independent of behavior, direct comparison between saline and losartan groups identified 13 unique DEGs at a statistical threshold of p<0.1 and one unique gene (at p<0.05), low density lipoprotein receptor-related protein 8 (Lrp8) involved in synaptic memory and plasticity. Among the uniquely expressed genes, only the losartan group comparison had differential expression for junction proteins Claudin- 5 and Gap junction beta-6 protein with gene ontology results indicating an inhibition in biological adhesion (7.8% vs 2.3%) process for losartan group.

Our findings indicate that losartan, administered shortly after memory retrieval, reduces long-term but not short-term memory, while altering the differential expression of specific genes in the BLA.

Neuroscience

Institute for Biomedical Sciences (PhD Students in IBS Only)

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Michael Bukrinsky

ABSTRACT

HIV-1 Nef Disrupts Oligodendrocyte Morphology and Myelin Integrity in the Central Nervous System

HIV-associated neurocognitive disorder (HAND) is a spectrum of cognitive impairments that remain a common consequence of HIV infection. While the advent of combined antiretroviral therapy (cART) has substantially reduced the most severe forms of HAND, milder forms continue to affect 30-50% of HIV-positive individuals. Clinical and experimental studies have implicated preferential white matter damage in HAND pathogenesis, but the mechanisms underlying HIV-associated demyelination remain unknown. Our lab has previously shown that the HIV-1 accessory protein Nef is released from cells in extracellular vesicles (EVs) and impairs cholesterol efflux from macrophages in the periphery by downregulating and inactivating a critical cholesterol transporter, ATP-binding cassette A1 (ABCA1). Since oligodendrocytes require cholesterol for the synthesis, formation, and potentially the maintenance of myelin sheaths in the central nervous system (CNS), the current study examined the effects of Nef EVs on oligodendrocyte morphology and myelin structure as well as ABCA1 expression in the CNS. EVs carrying recombinant Nef were produced by transfected HEK293T cells and applied to mouse spinal cords in vivo, mouse cerebellar slice cultures ex vivo, and mixed rat cortical cultures in vitro. EVs produced by cells transfected with an empty vector served as control. Immunohistochemical analysis of Nef EV-injected spinal cord white matter from adult mice showed decreased myelin basic protein (MBP) immunoreactivity consistent with myelin lesions that were not observed in controls. Nef-treated cerebellar slice cultures also showed decreased myelin along cerebellar axons, indicated by decreased ratio of MBP to MBP + medium chain neurofilament (NFM) immunoreactivity. Furthermore, treatment with Nef EVs resulted in morphological disruptions of mature oligodendrocytes and decreased ABCA1 protein expression in vitro. Together, these data suggest that Nef perturbs myelin integrity in the CNS, impairs mature oligodendrocytes, and alters ABCA1 expression in cortical cells. Further work will examine the role of ABCA1 and reverse cholesterol transport in Nef-mediated myelin impairment.

Neuroscience

Institute for Biomedical Sciences (PhD Students in IBS Only)

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Jason Triplett

ABSTRACT

NMDA Receptors are Required for Visual Map Alignment in the Superior Colliculus

Efficient processing sensory information is a critical function of the nervous system. In many visual areas, neuronal connections are organized topographically, where neighboring neurons monitor adjacent regions. For instance, retinal ganglion cells (RGCs) project topographically to two image-forming areas: the superior colliculus (SC) and dorsal lateral geniculate nucleus (dLGN). The SC also receives topographically ordered inputs from the primary visual cortex (V1), which are aligned with terminals from RGCs monitoring the same region of space. Previously, we showed that retinal inputs instruct the alignment of V1 inputs in a manner dependent on spontaneous correlated activity. However, the mechanisms by which activity instructs visual map alignment remain unclear. Based on their expression pattern in the developing visual system and known role in activity-dependent synaptic plasticity, N-methyl-D-aspartate receptors (NMDARs) are ideally positioned to mediate map alignment. To directly test the role of post-synaptic NMDARs in the development of visual map alignment, we utilized a conditional genetic strategy to specifically ablate NMDAR function in the SC (Tal1CreERT2).

To assess visual map alignment, we focally labeled a small subset of V1 neurons with DiI at P10 and visualized the termination zones (TZs) of labeled V1 neurons in the SC in sagittal section at P12. Our data suggests that NMDARs expressed in the SC are required for corticocollicular map formation.

Neuroscience

Institute for Biomedical Sciences (PhD Students in IBS Only)

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RESEARCH MENTOR/DEPARTMENT CHAIR

Kazue Hashimoto-Torii

ABSTRACT

Dysregulated Central and Peripheral Lipidome in a Mouse Model of FASD

Fetal alcohol spectrum disorder (FASD) is caused by alcohol consumption during pregnancy. Consumed alcohol crosses the placenta and affects fetal brain development. Despite its high prevalence and life-long medical cost, there is no standardized diagnostic tools or treatments available yet. In our previous work, single-cell RNA sequencing found that the expressions of fatty acid synthesis/metabolism-related genes are upregulated in a subpopulation of neurons in the motor cortex of an FASD animal model. These animals also present motor skill learning deficits, which is one of the characteristics of children with FASD. Consistent with our previous RNA-sequencing results, the current study confirmed dysregulated lipid metabolism in the motor cortex of the FASD animals by immunohistology and quantitative analysis of fatty acids profile. We observed a significant increase in lipid droplet accumulation using oil red o staining. Mass spectrometry analysis revealed a significant increase in palmitate and arachidonic acid specifically in phosphatidylethanolamine (PE) - one of the major phospholipids. To identify biomarkers that are associated with dysregulated lipid metabolism and motor function deficit in our FASD animal model, we further performed RNA sequencing on white blood cells, which have lipid clearance function in the periphery. The results showed that B-cells from FASD animals have significantly less Apolipoprotein E (ApoE) expression. Notably, the expression levels of ApoE in B-cells were strongly correlated with the motor learning ability of each animal. ApoE is one of the Alzheimer's disease (AD) risk genes, and studies showed a strong correlation between the levels of apoE in plasma and cognitive test scores of AD patients. Overall, our data propose a novel pathophysiology model of FASD; overburden of lipidome in both brain and periphery augments neurobehavior deficits and other associated problems in the patients with FASD.

Neuroscience

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Abigail Polter

ABSTRACT

Early Life Stress Results in an Atypical Defensive Behavior in Mice

Defensive behaviors are a crucial aspect of survival and conservation of species. The ability to correctly develop and execute defensive strategies in response to threats is a complex process that is influenced by the serotonergic system. The dorsal raphe nucleus (DRN) provides significant serotonergic (5-HT) innervation to multiple brain areas, and previous work has shown that early life stress (ELS) can cause disruptions to the development of these 5-HT circuits in the brain. Dysfunction of such neuronal circuits has been implicated in a variety of clinical conditions including mood, fear and anxiety disorders. Adverse experiences during early life significantly enhance the risk for the development of emotional and threat-related pathologies. One paradigm used to study ELS in the mouse is the limited bedding and nesting (LBN) model, in which dams and pups are placed in a low resource cage for seven days. This leads to disrupted maternal care, and results in alterations to the 5-HT systems of pups. How these adaptations to the 5-HT circuits affect naturalistic defensive responses and contribute to the development of fear-related disorders is unknown. In order to test the effects of ELS on defensive behaviors, we utilized a Looming Disk (LD) behavioral assay. In the mouse, looming stimuli mimic the approach of aerial predators, and evoke innate, species-specific defensive behaviors such as running and freezing. Previous work shows that looming stimuli evoke responses from retinal ganglion cells that then send projections to the DRN. These projections activate DRN GABAergic cells, which in turn inhibit DRN 5-HT cells. Inhibition of DRN 5-HT cells is essential for the proper execution of defensive behaviors, as disinhibition of the 5-HT cells in the DRN leads to an absence of defensive responses. We hypothesize that mice subjected to LBN have altered 5-HT transmission within these circuits, and therefore cannot properly execute typical defensive responses. To test this, we will perform LD tests on adolescent and adult mice exposed to a LBN protocol. In preliminary studies, we find that mice exposed to a LBN protocol exhibit atypical defensive responses such as darting at a higher frequency than control mice. This work is complimented by additional preliminary work showing that increased 5-HT transmission due to SSRI's causes an inhibition of defensive responses. Our future work will aim to prove what alterations to the 5-HT system result from ELS, as well as the role that altered 5-HT transmission plays in atypical defensive responses.

Neuroscience

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Christopher Leon Guerrero

ABSTRACT

The Dual Emergency When Race and Ethnicity Meet Stroke Medicine: A Review Exploring Disparities in Stroke Prevention

According to the CDC, more than 795,000 individuals in the United States will experience a stroke each year, 140,000 of whom will die as a result. It is well established that the risk of stroke and subsequent mortality is not distributed equally among all races and ethnicities. Compared with nonhispanic whites, both black and latinx individuals are likely to experience stroke at a younger age. Moreover, risk of first stroke is twice as high for latinx individuals and 2 to 4 times higher for blacks than for nonhispanic whites. The increased risk of stroke associated with these groups is strong enough that both race and ethnicity are included as nonmodifiable risk factors for stroke. The literature has already demonstrated disparities in the administration of thrombolytics and in level of in-hospital stroke care. Further, epidemiology of several unmodifiable risk factors for stroke themselves include race and ethnicity. This review seeks to explore the contribution of race and ethnicity to stroke incidence through disparities in risk factor mitigation for stroke prevention.

A systematic search is being conducted of Medline and EMBASE for studies performed on race and ethnicity in stroke risk factors. The keywords used for search of the database include "race," "ethnicity," "stroke," "risk factor," "implicit bias," "disparities." Studies published between 2010 and February 2020 were included. Only studies addressing the modifiable risk factors of stroke identified by the INTERSTROKE case-control trial were included: hypertension, diabetes, current smoking, abdominal obesity, hyperlipidemia, physical inactivity, alcohol consumption, diet, psychosocial stress and depression, cardiac causes. Those dealing with nonmodifiable stroke risk factors other than race and ethnicity were excluded. Studies were also excluded if race/ethnicity were not analyzed as subpopulations or if the studies were retracted from publication.

The review is ongoing, but it is expected that modifiable risk factors for stroke will themselves reveal disparities in treatment or counseling from health care providers, potentially pointing to widespread implicit bias on the part of either provider or patient. There is a need for further studies explicitly exploring implicit bias on the part of providers in primary and secondary stroke prevention. If found, this could provide an important avenue for improvement in stroke incidence.

Neuroscience

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Jeffrey Rothstein

ABSTRACT

Mutant Huntingtin Disrupts the Nuclear Pore Complex

Huntington's disease (HD), the most common inherited neurodegenerative disease, is caused by an expanded CAG repeat in the first exon of the Huntingtin (Htt) gene, resulting in progressive degeneration of striatal medium spiny neurons. Disease onset and severity are dependent on CAG repeat length. The mechanism(s) by which mutant Htt (mHtt) causes the disease have not been fully elucidated. The trafficking of RNA and proteins between the cytoplasm and the nucleus is a critical aspect of signal transduction and is especially arduous for neurons due to their highly polarized biology. Efficient regulation of this process is mediated by the Nuclear Pore Complex (NPC), an extraordinary molecular machine that serves as the main gateway to the nucleus. In order for any cell to function properly, it is imperative that RNA and protein be efficiently and selectively exchanged between the nucleus and the cytoplasm. This critical task is achieved by the ~2000 NPCs that span the entire nuclear envelope. Each NPC consists of multiple copies of 30 different protein subunits called Nucleoporins (NUPs) that differ in anatomical location, function, domain, post-translational modification and residence time. Mutations in various NUPs result in tissue-specific diseases. Interestingly, some of the longest-lived proteins in the mammalian brain are specific NUPs and may represent the "weakest link" in the aging proteome. Prior studies offered clues that mHtt may disrupt nucleocytoplasmic transport and a rare mutation of a specific NUP can cause HD-like pathology. Given these, we extensively evaluated the NPC and nucleocytoplasmic transport in multiple models of HD including various transgenic and knock-in mouse models, human adult and juvenile HD brain regions, HD iPSC derived neurons, and primary neurons transfected with full length mHtt. Collectively, our models display severe mislocalization and aggregation of NUPs that co-localize with mHtt, a disruption in the energy gradient that fuels nuclear trafficking, and increased nuclear permeability indicating a defect in the gating of the NPC. Repeat-associated non-ATG translation, which has been shown to disrupt nucleocytoplasmic transport in C9orf72 ALS-FTD, also occurs in HD and disrupts nucleocytoplasmic transport. Our studies show that products of the mHtt repeat expansion are likely to disrupt nucleocytoplasmic transport at the NPC. Additionally, drugs that prevent aberrant NUP biology also mitigate this transport defect and neurotoxicity. This study suggests that the NPC is disrupted in HD and offers novel therapeutic targets.

Neuroscience

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Abigail Polter

ABSTRACT

Effects of Early Life Adversity on Social Behavior

Experiences during early life produce enduring changes on brain and behavior. As the main source of environmental stimuli, maternal caregiving has a profoundly influential role on developmental sensory experiences and behavior of offspring. Notably, maternal care can also be altered by environmental factors experienced by mothers. For example, under stressful conditions mothers display reduced nurturing behavior toward offspring. Adult offspring that interacted with stressed mothers during early life are at increased risk for expression of maladaptive behaviors. A better understanding of the behavior sequelae resulting from early life adversity could provide the groundwork for more efficient therapeutic interventions for neuropsychiatric disorders. Here we examined the behavior consequences in terms of social behavior of adult offspring that were exposed to an adverse experience during early life. We employed a fragmented maternal care approach based on a limited bedding/nesting (LBN) model in mice. In this approach, dam and pups at postnatal day 4 (PND 4) were subjected to a low-resource environment until pups have reached PND 11, and afterwards returned to their regular cage. We first compared the time that an adult mouse that was exposed to LBN spent interacting with a novel male and female unfamiliar mouse. LBN mice did not show altered sociability compared to controls when interacting with a male unfamiliar mouse, but demonstrated a significant reduction in time interacting with an unfamiliar female mouse. Additionally, we found that this is not sex-specific as both female and male LBN mice spent less time interacting with the female unfamiliar mouse. To assess social recognition in LBN mice, 1 h after the social interaction test LBN and control mice were re-exposed to the same mouse that was encountered before. Male, but not female LBN mice spent more time exploring a previously encountered male mouse compared to controls, suggesting a deficit in social recognition in male mice. We further employed a resident-intruder assay to assess the effects of aggressive behavior on inter-male social interaction. In contrast to control male mice, which exhibited aggression towards a smaller intruder, we found that LBN male mice did not display aggressive behavior. Together, these results indicate that mice exposed to early life adversity based on LBN protocol exhibit deficits in social approach, which is indicative of increased anxiety-like behavior. These data provide novel insights to understand the impact of adverse experiences on social behavior and its correlation with enhanced risk for developing mental illness.

Neuroscience

School of Medicine and Health Sciences

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ABSTRACT

Cellular and Microstructural Brain Alterations in a Piglet Model of Cyanotic Congenital Heart Disease

Significant neurodevelopmental delay is emerging as one of the most important current challenges for patients with congenital heart disease (CHD). Previous clinical studies demonstrate that reduced oxygen delivery due to CHD results in subnormal brain development1,2. The piglet brain is a powerful new tool to study human brain development. We hypothesize that studies using the piglet model of chronic cerebral hypoxia will allow us to understand the underlying cellular events of chronic hypoxia in perpetuating neurodevelopmental damage in children with CHD3. This study aims to evaluate the effect of chronic hypoxia on piglet brains through histological, DTI (diffusion tensor imaging) and NODDI (neurite orientation dispersion and diffusion imaging) analyses to determine the regional difference in the brain damage in CHD. Piglets were exposed to either chronic hypoxia (10.5% O2: H(x) group, n=12) or sham hypoxia(21% O2: N(x) group: n=12) from P3 to P14. Six piglets from each group were euthanized at day 14 (2-week N(x) and 2-week H(x)), and another 6 piglets from each group were subjected to grow under normal oxygen conditions from day 14 to 6 weeks of age (6-week N(x) and 6-week H(x)). Brains were extracted from piglets and examined using 1)immunohistochemical assays (Olig2+, CC1, PDGFR-α) to assess the cellularity alterations in white matter following chronic hypoxia, and 2) DTI (including FA, AD, RD, and MD1 images)1 FA (Fractional Anistropy), AD (Axial Diffusivity), RD (Radial Diffusivity), MD (Mean Diffusivity)and NODDI (including NDI, ODI, and KAPPA2 images) neuroimaging techniques. MRI-based piglet brain atlases were applied on DTI and NODDI images to evaluate structural differences between Hx and Nx brains. 2-week Nx brains revealed a significant increase in the density of CC1-positive cells compared to 2-week Hx brains in white matter. A significant increase of fractional anisotropy (FA) intensity was also observed in the peripheral white matter of Nx brains compared to Hx brains at 2 weeks (Figure 1). Although the differences of FA intensity in the peripheral white matter disappeared between Nx and Hx at 6 weeks, central deep white matter revealed a significant decrease in FA intensity in Hx brains vs Nx brains at 6 weeks. Radial diffusivity (RD) mapping demonstrated a significant increase in the right anterior cortex in 2-week Nx brains compared to 2-week Hx brains. Orientation Dispersion Index (ODI) mapping also revealed a significant increase in central white matter regions between 2 weeks Nx and Hx (Figure 2). KAPPA mapping a significant increase in central gray matter regions between 2 weeks Nx and Hx. The results reveal different cellular and microstructural alterations after chronic hypoxia between deep and peripheral regions in the piglet white matter.

Neuroscience

School of Medicine and Health Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

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ABSTRACT

Variations of Deep Medullary Veins Appearance in Dynamic CT-Angiograms of Healthy Individuals

Deep medullary veins (MV) are a set of small venous structures coursing through the corona radiata, and draining into the deep venous system. Asymmetric prominence of the MV ipsilateral to the side of an acute infarct on MRI examination has been shown to be an independent predictor of poor clinical outcome by Yu X et al. The appearance and number of MV appear to vary in a CT angiogram (CTA), depending on the timing of the bolus and images acquisition. Evaluating these structures in a multiphase CTA can potentially avert this problem. The purpose of this study was to establish the normal CTA appearance of MV among healthy individuals, as a means of determining the feasibility of this tool in evaluating patients with an acute infarct. In this IRB approved retrospective study, we analyzed all multiphase CTA examinations obtained for the evaluation of neurological symptoms from 09/01/18 to 05/01/19. Only patients with negative imaging and confirmed resolution of neurological symptoms by the time of hospitalization were included. The majority of these patients also had an MRI confirming the absence of acute stroke. Other exclusion criteria were the presence of an urgent medical condition, and the presence of remote territorial infarction. The number of MV was counted in both hemispheres during the most optimal phase of the multiphase CTA. MV asymmetry was defined as > 5 MV on one side as compared to the other. The comparison in quantity of visualized MV between three age groups and genders was analyzed by the Mann-Whitney U test. Forty-four patients met all inclusion and exclusion criteria. The patients' age range was between 25-91 yo, with a mean 57.1. 18/44 were males and 26/44 were females. The patients were divided into three age groups: < 55 yo (15 patients), 56-60yo (14 patients), >61 years old (15 patients). MV were best visualized in the arterial phase in 34 studies and in the early venous phase in 10 studies. Unilateral prominence of MV was seen in 2 (4.5%) patients. The overall number of visible MV varied from 6 to 27. There were no statistically significant differences in the number of visible MV among age groups and genders ($p > 0.05$). MV can be reliably visualized with multiphase CTA. The symmetric appearance of the MV was noted in greater than 95% of healthy individuals. The overall number of visualized medullary veins widely varied among healthy individuals.

Neuroscience

School of Medicine and Health Sciences

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ABSTRACT

Role of Kappa Opioid System in Stress-Induced Anxiety- and Depressive-Like Behaviors

Women are twice as likely as men to be diagnosed with a mood or anxiety disorder. Given that stress plays a significant role in the development of these disorders, sexual dimorphism in the response to stress are likely to be a critical factor in the enhanced vulnerability of females to mood and anxiety disorders. Across both human populations and animal models, males and females exhibit divergent responses to stress at all levels, from molecular signatures to behavioral adaptations. Sub-chronic variable stress (SCVS) is a model of depression and anxiety in which female mice develop anhedonia and anxiety but males do not.

Dysregulation of the mesolimbic reward circuitry is implicated in the pathophysiology of stress-related illnesses such as depression and anxiety. Dopaminergic (DA) neurons in the ventral tegmental area (VTA) are a major target of stress. Previous data has shown that stress blocks or inhibits a long term potentiation of GABAergic synapses onto the DA neurons (LTPGABA). Interestingly, the block of LTPGABA is prevented by pre-treatment with the kappa opioid receptor (KOR) antagonist NorBNI. We hypothesize that pre-treatment with NorBNI would also prevent the stress-induced behavioral deficits observed in females.

In our study, we first confirmed that SCVS causes social deficits and depressive-like behaviors in female mice only. Interestingly, those deficits are prevented by a pre-treatment with NorBNI. Our data indicates the important role of the kappa opioid receptor in the development of maladaptive behavioral responses.

Obesity

School of Medicine and Health Sciences

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ABSTRACT

Mesenchymal Stromal Cells (Mscs) Up-Regulated With Both Mitochondrial and Cytosolic Antioxidants Improve Non Alcoholic Fatty Liver Disease (NAFLD) in Diet Induced Obesity (DIO) Mouse Model

Elevated oxidative stress by reactive oxygen species and mitochondrial dysfunction have been implicated in diabetes and obesity leading to insulin resistance (IR). Based on our previous study, we investigated to see the effect of two anti-oxidants (one mitochondrial, SOD2 and another one cytosolic, catalase) upregulated together in MSCs and delivered intra peritoneally (IP) in DIO mouse model.

C57BL/6J male mice (4–6weeks old) were obtained from the Jackson Lab. Obesity, glucose intolerance, and insulin resistance were induced by feeding the mice a high-fat diet (HFD) for 13 weeks. Mouse adipose-derived MSCs and adenovirus constructs containing GFP (Null, SOD2 and Catalase), were purchased Commercially. Glucose tolerance test (GTT), liver and fat depots H& E staining were performed and liver triglycerides (L-TG) were quantified.

A significant reduction in L-TG levels were observed in the mice that received Catalase+SOD2-MSCs (2-fold) compared to Null-MSC, which was less than noted either with catalase or SOD2-MSCs alone. This is consistent with the findings of the corresponding liver fat histology. The systemic inflammatory maker plasma TNF-α levels in mice injected with the combination antioxidants showed 1.5 fold decrease compared to Null-MSC though SOD2-MSCs or catalase-MSCs almost demonstrated a decrease compared to Null-MSC. GTT showed an improvement with combination therapy with total area under the curve (AUC) value less than other groups

Our results indicate that MSCs with upregulated both Catalase and SOD2 anti-oxidants were more effective in reducing systemic inflammation (plasma TNF-α) and liver triglyceride content in DIO mice. MSC mediated delivery of combination of antioxidants, intra-peritoneally is safe and can be used as an efficient tool for treating obesity, prediabetes and NAFLD.

Prevention and Community Health

Children's National Medical Center

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Maureen Monaghan

ABSTRACT

Diabetes-Related Topics Discussed in Medical Visits and Self-Management in Adolescents and Young Adults with Type 1 Diabetes

Routine clinic visits with diabetes health care providers (HCPs) offer adolescents and young adults (AYAs) with type 1 diabetes (T1D) important health information. Evaluate associations among diabetes self-management skills and topics discussed in clinic visits.

28 AYAs (M age =17.58 years±1.06; 54% female; 43% non-Hispanic white; M baseline A1c=9.12±2.04%) and 7 HCPs participated in a longitudinal study of health communication. AYAs had up to 4 routine diabetes clinic visits audio recorded (65 total visits; M visits/participant=2.32; M duration=21.62 minutes). AYAs completed the Self-Management of Type 1 Diabetes in Adolescents (SMOD-A) scale, which assesses Collaboration with Parents, Diabetes Care Activities, Problem Solving, Communication, and Goals. Correlations and independent samples t-tests were conducted to assess relationships among demographic characteristics, diabetes self-care domains, and topics discussed during clinic visits.

SMOD-A scores did not differ by AYA age or sex. At baseline, non-Hispanic white participants reported lower Collaboration with Parents than participants of other ethnicities ($p<.05$). Higher A1c was associated with lower SMOD-A Diabetes Care and Goals subscale scores ($ps<.05$).

The following topics were discussed: objective indicators of T1D (100%), adherence (93.8%), lifestyle (69.2%), environment (70.8%), transition to adult diabetes care (6.2%), sexual health (10.8%), and substance use (7.7%). Higher A1c was associated with more discussion of adherence and environment ($ps<.05$). Higher SMOD-A Diabetes Care score was associated with less discussion of adherence ($p<.05$), and higher Goals was associated with more discussion of transition to adult care ($p<.05$).

Results suggest adherence was more often discussed with AYAs who reported lower self-management skills, and transition to adult care was often discussed with AYAs who reported more diabetes goals. Discussions regarding diabetes-related developmental topics are important to develop AYA self-management skills. Future research should examine AYA contributions to clinic discussions and identify important topics for diabetes care.

Prevention and Community Health

Milken Institute School of Public Health

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ABSTRACT

A Social Determinants of Health Framework for Barriers to Tuberculosis Prevention and Care Among Non-US Born Patients

Tuberculosis (TB) is the leading cause of death among infectious diseases globally. In 2018, 9,025 cases of TB were reported across the US with an incidence of 2.8 cases per 100,000 persons. However, TB disproportionately affects non-US born (non-USB) persons. In 2017, 70% of the total cases of TB in the US were among non-USB, making them 14 times more likely to have TB than those born in the US.

The cascades of care for latent tuberculosis infection (LTBI) and active TB infection are lengthy and challenging, leading to high patient attrition. Among persons with active TB in high-burden settings, 68% accessed initial testing and only 43% successfully completed treatment (Subbaraman, 2019). For non-USB populations with LTBI, only 43% completed screening and only 14% completed treatment (Alsdurf, 2016). We hypothesized that gaps in the TB and LTBI cascades of care, especially among non-USBs in the US, are driven by social and structural patient-level barriers to care.

We aimed to conduct a scoping review that (1) describes barriers to LTBI and TB care for non-USB patients by using a social determinants of health (SDH) framework as defined by Healthy People 2020 and (2) maps the results of the scoping review to a conceptual framework. First, a search strategy was implemented using PubMed, resulting in 15 articles to be included for the full analysis. Inclusion criteria consisted of studies that were published in 1991 or later, identified facilitators and/or barriers to TB prevention and care among non-USB populations, collected data directly from the patients, either through quantitative, qualitative, or mixed methods research, and were published in the US from a peer-reviewed journal in English. Papers meeting the criteria were evaluated for the following themes: economic stability, social and community context, healthcare, education, and neighborhood and built environment. The initial search identified 148 studies after the removal of duplicates. 127 studies were excluded on the basis of title and abstract. 21 full texts were assessed for eligibility and 15 were included for full analysis.

Our results showed that among the limited evidence, determinants such as economic stability, social and community context, and health and healthcare were most frequently identified as enabling prevention and care for non-USB persons. More research is needed to better understand how these patient-level barriers to TB prevention and care impact both patient and population level outcomes.

Prevention and Community Health

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ABSTRACT

A Comparative Analysis of University Wellbeing Models

Wellbeing on college campuses is an increasingly popular topic as new research indicates that mental health concerns among college students are skyrocketing, with three out of five students experiencing overwhelming anxiety and two out of five students citing debilitating depression. Universities have tackled wellbeing in a variety of ways, from creating a center or department on campus solely dedicated to wellbeing to organizing a coalition of campus partners to centralize health promotion and related services. Though most universities are addressing student wellbeing on campus in some capacity, there has not been research on what type of wellbeing models, both structurally and substantively, are most effective for improving student health. This research is needed to support the establishment of a wellbeing model at the George Washington University.

Twelve of the George Washington University's market-basket schools were selected for inclusion. A comparative analysis of existing resources was performed to categorize the university's approach to campus wellbeing. Key informant interviews were conducted to confirm the initial university wellbeing structure, ascertain the relative strengths and weaknesses of their chosen model, monitoring and evaluation measures, and plans for the future. These key informant interviews provided the basis for a comparative analysis that informed the choice of two universities to conduct case studies through site visits with multiple stakeholder interviews and environmental landscaping.

The initial analysis found that of the 12 universities, 4 had created a centralized center for wellbeing on campus and 8 took a decentralized approach where departments were siloed to address wellbeing on their own. The key informant interviews will provide further information on the relative effectiveness of each to enhance wellbeing, development and implementation of associated measurement indicators, and the major barriers to success.

The results of the interviews and case studies will provide a basis to develop and implement a wellbeing model for GW. The experiences of similar 'market basket' universities will enable GW to anticipate potential challenges and solutions to effectively establish, monitor, and evaluate wellbeing and set GW as a template for others to emulate. This research will shed light on the how other universities have implemented a wellbeing model that fit the demands of their campus, especially at a time when mental health is a chief concern for colleges.

Prevention and Community Health

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ABSTRACT

Assessing Nurse Practitioner and Medical Student Experience and Self-Efficacy Caring for Patients and Families Living in Poverty

Purpose: There is a lack of data on the effectiveness of medical and nurse practitioner (NP) programs in preparing students to address the social determinants of health (SDH). The purpose of this study was to assess and compare medical and NP students' experience and self-efficacy caring for patients and families living in poverty.

Methods: This descriptive, cross-sectional study was conducted via online survey administered to a sample of 4th-year medical and 2nd-year primary care NP students. Ninety-eight (72 NP and 26 medical) students completed the survey, 34.8% and 15.8% of the classes respectively participated. The survey was administered via E-mails sent by NP program directors and medical school course directors, with several reminder E-mails. Results: A small percentage of medical and NP students rated their educational programs as excellent in preparing them for primary care practice and addressing SDH, however NP students felt more comfortable providing care to low-income patients than did medical students. Lack of time and knowledge of resources was the most significant barrier cited by both medical and NP students.

Discussion: Curricular redesign and intraprofessional education are areas of research to understand how to better prepare medical and NP program graduates to care for patients living in poverty.

Prevention and Community Health

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ABSTRACT

Telehealth at Faith-Based Organizations: Pilot Program for Wards 5,7, and 8

Despite recent advancements in medicine, racial and ethnic health disparities have undermined our current health care system. Specifically, in Washington, D.C., African American residents are significantly more likely than their white counterparts to suffer from complications of non-communicable, chronic disease processes such as coronary heart disease, hypertension, and diabetes. Compounded by a lack of preventative health care services and poor health literacy, morbidity and mortality outcomes have negatively impacted the Washington D.C. community. To address these disparities, a telehealth education campaign was implemented to specifically target health care challenges for African American residents in Washington D.C. living in Wards 5,7 and 8. The program represented a partnership between The Pennsylvania Avenue Baptist Church and The George Washington University Medical Faculty Associates. The main goal of the program was to increases the health literacy and digital health literacy for disease processes such as hypertension, obesity, stroke and diabetes. To accomplish this, churches and volunteers were recruited and trained to build pop-up kiosks at community events throughout Wards 5,7 and 8. Physicians, medical students, and community volunteers specifically discussed how technology applications on smartphones and laptops can help residents be more proactive regarding their own preventative health care. The number of sessions held, the attendance of residents, and the utilization data of technology applications were examples of metrics and milestones that were recorded. From the initial 8 sessions hosted, 240 residents most commonly from Wards 5,7, 8 and Maryland participated in the exercise. A total of 71 technology applications such as patient portals were downloaded. In addition, a total of 44 residents benefited from phone optimization services such as setting up medication alarms or Medical IDs on their smart devices. The initial data showcases the promising potential of technology applications to empower residents to improve their self-management and prevention of diseases. It also showcases the potential for increasing the usage of telemedicine services in underserved regions to increases the accessibility of healthcare. To make the initiative more sustainable in the future, a long-term partnership with churches in Wards 5,7 and 8 needs to be established. In addition, a larger promotional campaign needs to be in place to reach out to more residents who may benefit from these services.

Psychiatry/Mental Health

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ABSTRACT

Death Row Narratives: A Qualitative Analysis of Mental Health Issues Found in Death Row Inmate Blog Entries

A qualitative review of death row inmate blog was conducted using the public health theoretical lens of "upstream factors" (i.e., social determinants) of health. Traditionally in public health research, upstream factors are physical environments and actors within those environments -- like risk exposure and social inequalities -- which are analyzed in relation to the development of illness and individual action taken to prevent or treat illness. In this research, legal and correctional procedures discussed by inmates are considered upstream factors potentially bearing on their health. In measuring mental health decline and even deterioration, two perspectives were examined: (1) the notion of autonomy and powerlessness among death row inmates, developed by Robert Johnson (1981 & 2019), and (2) the public health theory, Locus of Control (LOC) developed by Philip C. Miller. LOC refers to the degree to which people attribute outcomes to themselves versus uncontrollable external forces. Research on LOC demonstrates that an individuals' perception powerlessness and lack of control is a stressor, which can influence somatic as well as mental health. The upstream environmental conditions analyzed in terms of powerlessness and LOC were: stay of executive, solitary confinement, death watch, date of execution, relationships with legal representation, and court proceedings. Each environmental factor were described in inmate blog entries as contributing to mental health decline. We offer recommendations to reform the current state of capital punishment procedures with consideration of upstream, environmental factors influencing mental health.

Public Health

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ABSTRACT

Health Consequences of Early Marriage in Ethiopia

Problem: Girls under the age of 18 are forced by the traditional laws and standards that are inherited by their parents to marry at a young age, robbing them of their childhood. Early marriage revokes these girls from making vital decisions about their sexual health and well-being and essentially denies them their human rights. After being married, the young brides are forced to leave school and are exposed to marital rape, so they can prove their fertility. Making these girls vulnerable to complications such as prolonged labor or painful childbirth and even death. Having these complications can lead to an abnormal connection between organs called fistula that is mainly caused by the underdevelopment of these mothers' bodies. These girls are also exposed to many sexually transmitted diseases due to them engaging in unprotected sex without acknowledging it. Married adolescents have a high risk for HIV infection as well as other sexually transmitted diseases. Despite all the sexual health risks these girls face they also deal with domestic violence, rape, and emotional abuse from their husbands.

Purpose: This research is meant to critically examine the health consequences of early marriage in Ethiopia and create a program that will stop the initiation of early marriage and propose a solution to this growing epidemic.

Gaps: The literature review exhibits that there have been multiple endeavors to bring awareness to the practice of early marriage in Ethiopia. Despite the level of awareness, there remains a lack of steps taken against this phenomenon.

Proposal: Creating a program, liberal feminist ideals, for adolescent girls in Amhara to encourage the goverment to enforce the laws in governing early marriage and change the minimum age to getting married to 22.

Public Health

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ABSTRACT

Using Silica-Hydride Based Stationary Phases for the Ultra High Performance Liquid Chromatography (UHPLC) Separation of Synthetic Cathinone Positional Isomers

The separation and identification of positional isomers can be difficult. Tandem techniques such as gas chromatography mass spectrometry (GC-MS) and liquid chromatography (LC) MS are employed for the analysis of emerging drugs. While GC offers several limitations, LC (high performance liquid chromatography (HPLC) or ultra-high performance liquid chromatography (UHPLC)) allows for the direct analysis of these compounds. Analysis can be conducted using reversed phase (RPC) or hydrophilic interaction (HILIC) chromatography.

For silica-hydride (SiH) based stationary phases, under aqueous normal phase (ANP) conditions, a negligible water layer exists surrounding the stationary phase. ANP chromatography, similar to HILIC, employs an aqueous mobile phase with high organic content. A favorable aspect of SiH columns is that they can be operated under both RPC and ANP modes. This dual-mode capability is highly advantageous in that a single sample can be run under both chromatographic modes using the same solvent reservoir solutions and with the same column. This methodology yields orthogonal retention times, thereby significantly increasing the reliability of compound identification.

A mixture of 8 synthetic cathinone positional isomers was analyzed by UHPLC-PDA/MS. Several SiH columns were run under RPC and ANP conditions. Results were compared to those of classical columns: C18, Silica, and Pentafluorophenyl (PFP). "Optimum" separation conditions were determined for each column, and column selectivity, reversibility, and repeatability were explored.

Significant selectivity differences were observed using bi-modal columns and between different stationary phases. The SiH Silica-C column, which contains no derivatized ligands attached to the silica-hydride backbone, not only gave the most orthogonal separations of the bi-modal columns, but provided a unique separation of all 8 positional isomers (resolution>1) using the combination of RPC and ANP. Although the combination of RPC and HILIC columns gave an orthogonal separation of all 8 isomers, long equilibration times were required using HILIC. In contrast, the Silica-C column under ANP conditions, produced great separation and repeatability, with significantly shorter equilibration times. The ability to use a single column to perform two types of orthogonal chromatographic separations would be beneficial for the separation of positional isomers of emerging drugs.

Public Health

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ABSTRACT

Investigating D.C. Opioid Use Disorder Demographics and Co-Occurrences in Inpatient and Outpatient Electronic Health Records — 2015-2019

The opioid crisis remains a pressing issue in the United States. However, there is still little consistent data regarding population demographics and common co-occurrences. As the opioid use disorder (OUD) population is especially vulnerable with profound rates of poverty and homelessness, missing basic information concerning OUD patients invites potentially imprecise treatment strategies. The objective of this study is to provide some of these essential demographic statistics about the urban Opioid Use Disorder population. This information was compiled via the utilization of Electronic Health Records from the only inpatient psychiatric hospital in the District of Columbia. Over a four year period, inpatient and outpatient (n=2,581) demographic data and patient insurance rates are considered, including a comparison to existing data from the D.C. Chief Medical Examiner. In addition, medical comorbidities and co-occurring substance use disorders are presented for both populations.

Public Health

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ABSTRACT

Prescribing PrEP: Expanding HIV Prevention Training for Healthcare Providers Based on PrEP Familiarity and Experience

Although pre-exposure prophylaxis (PrEP), a highly effective daily pill to prevent HIV, has been approved by the FDA since 2012, only 90,000 PrEP prescriptions were filled in 2015, despite 1.1 million Americans being at risk for HIV that same year. To help alleviate this prescription gap, there is a need for PrEP training initiatives to shift healthcare providers further down the PrEP implementation cascade (i.e., awareness of PrEP, willingness to prescribe PrEP, discussion of PrEP with patients, and actual prescription of PrEP). Our study sought to identify distinct PrEP training profiles that emerged for content recommendations and format preferences. We then examined if providers' current stage on the implementation cascade predicted their specific training profiles.

Participants were 355 healthcare providers from across the United States who were practicing clinicians with prescription privileges (50.7% female; 48.7% male; 0.6 other self-identified gender). Participants were surveyed online from 2016-2017 as part of a larger study to develop an educational intervention for providers. Participants provided information on their clinical background, general familiarity with PrEP to determine their stage along the implementation cascade, and PrEP training content recommendations and format preferences. Progression along the implementation cascade was examined as a predictor of PrEP training recommendation and preference profiles, which were identified through latent class analysis.

Three distinct profiles emerged for PrEP training content recommendations: PrEP Clinical Guidelines Only, PrEP Clinical Guidelines and PrEP Background, and PrEP Clinical Guidelines and Comprehensive Sexual Health Background. Four distinct profiles emerged for PrEP training format preferences: Case-Application Only, Lecture Only, Non-Interactive Case-Application and Lecture, and Interactive Case-Application and Lecture. Progression along the implementation cascade was predictive of class membership for PrEP training content recommendations but not for format preferences. Providers who had progressed further along the PrEP implementation cascade were more likely to recommend PrEP Clinical Guidelines and Comprehensive Sexual Health Background.

Public Health

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ABSTRACT

QTL-based Analysis from Single cell RNA Sequencing Data

Single cell RNA sequencing (scRNA-seq) presents the unique opportunities to identify new cell sub-populations, to discover unique individual cells, and to study intra-cellular molecular correlations. Specifically, with the recent technological advances, scRNA-seq allows analyses of correlations between single nucleotide variants (SNV) and gene expression, with the aim to identify SNVs with potential regulatory features.

We analyzed scRNA-seq data generated on 10x Genomics Chromium platform from 26,640 human adipose-derived mesenchymal stem cells obtained from 3 healthy female donors. After SNV-aware alignment (STAR-WASP) and variant call (GATK), we estimated allele expression from heterozygous SNV loci, which we defined as expressed Variant Allele Frequency (VAFRNA= nvar/(nvar+nref), where nvar and nref are the number of unique sequencing reads encompassing the SNV locus of interest). In parallel, we estimated the gene expression (featureCounts) and determined cell types (Seurat). We used UMI-tools to remove PCR deduplicates and Seurat to regress out batch effects across the samples and cell cycle-related heterogeneity.

We next applied Quantitative loci trails (QTL)-based analysis to look for pairwise correlations between VAFRNA and gene expression. Our results suggest wide-spread and significant correlations between SNVs and gene expression in both cis (same gene) and trans (across genes) mode. We also observed concordance with known significant QTLs reported in the Genotype-Tissue Expression (GTEx) database. Our study shows that VAFRNA from scRNA-seq data can be used in QTL-based studies to assess genetic regulatory networks.

Public Health

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ABSTRACT

EMS Optimization Models with Survival Function

Out-of-hospital cardiac arrest (OHCA) is a significant public health issue and a leading cause of death among adults in the United States. We propose new survival maximization models (SOM) that implement the idea of survival function in emergency healthcare. The key features of the SOM models are the incorporation of the survival function and the minimization of the response time. A survival function is monotonically decreasing with the overall response time that returns the probability that a patient will survive beyond any given specified time. To improve the survival rate, we seek to minimize the overall response time, which is defined as the sum of the travel time and waiting times. We model the waiting time as an endogenous source of uncertainty in order to capture the impact of decisions on the waiting time and to have a more accurate representation of the overall response time. We propose an algorithmic framework involving convex reformulation methods and algorithms to solve the corresponding problems. We conduct an extensive series of numerical tests to evaluate the scalability and efficiency of the methods. Finally, we derive practical insights and demonstrate models' effectiveness for different classes of survival functions by using emergency response data obtained from the city of Washington, DC.

Public Health

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ABSTRACT

Drift Correction and Curation of Liquid Chromatography Tandem-Mass Spectrometry (LC-MS) Metabolomics Data for High Sensitivity Pattern Discovery

Metabolites are products of metabolic pathways. These small molecules provide several functions in our bodies such as cell signaling and stimulating and inhibiting enzymes. Examples of metabolites include lactic acids and certain amino acids. Metabolites are great biomarkers to investigate human health and to predict diseases, such as atherosclerosis and Inflammatory Bowel Diseases (IBDs). Liquid Chromatography-Mass Spectrometry (LC-MS) combines two standard laboratory techniques, liquid chromatography and mass spectrometry, to separate the metabolites and in a sample. LC-MS is a powerful technique to measure metabolites and proteins, at the same time sensitive to processing factors (batch effects). It provides metabolite information for a sample, such as retention time, mass to charge ratio, and intensity.

Metabolite data contains peak area drift within and between sample batches. We conducted computational scaling approaches (e.g. normalization, standardization, and transformation), which are experimental techniques to produce baselines for correcting the peak area drift and reduce batch effects. For the data preprocessing, diverse scaling methods such as auto-scaling, Pareto scaling, and level scaling are used and compared to enhance the interpretation of the data. Though LC-MS routinely measures metabolites with excellent precision, LC-MS is a highly sensitive technique that poses several challenges, such as fragments and adducts of metabolites. To assemble the fragments, we used the structure and descriptors of the fragment (e.g. mass to charge ratio and retention time) and their co-occurrence to find original metabolites from samples.

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ABSTRACT

Automated Liquid Handling Robots for DNA Extraction and Liquid Handling: User Perspectives and Assessment of Impact on Research.

Liquid handling is a fundamental task in biomedical and life science research laboratories. When conducting tasks such as genomic DNA extraction, the accuracy level required is often within microliters or nanoliters. Typical laboratory tasks include repetitive liquid aspirating, dispensing, mixing, and dilution, and accuracy often has an inverse relationship to speed during these manual tasks. The demands of the modern research lab and rise of large scale microbiome and genomic studies require novel solutions to maintaining accuracy in the laboratory while increasing throughput. The advent of automated liquid handling robots may allow researchers to increase throughput while maintaining accuracy, and increase productivity on higher level tasks.

The Hamilton Star regularly began running protocols in 2019. Methods included nucleic acid extractions, nucleic acid cleanups, and high throughput liquid transfer tasks. Features on the robot platform included a positive pressure unit, 96-channel pipette head, and heater/shaker units. Five researchers at the Antibiotic Resistance Action Center participated in a user experience survey, all of whom ran protocols on the robots, and two with experience programming and maintaining the robots. No users had formal training in automation or robotics. The survey asked questions regarding usability of the robots, overall impressions, future directions, and impact on other research tasks. Quantitative metrics over the course of a year were collected from each run on the robots to ascertain potential time saved, and error rates.

The Hamilton Star ran 10 protocols for a total of 198 runs during 2019, with a total run time of 100.9 hours. This is equivalent to approximately 13 full eight-hour work days. Error rates ranged from 0% to 9.3% depending on the method. On a scale of 1-5 with 1 being strongly disagree and 5 being strongly agree, users found that the robots are user-friendly for running protocols (mean: 4), reliable and robust (mean: 4.2), allow users to focus on higher-level tasks (mean: 4.4), and help save time by finishing lab work efficiently (mean points: 4). However, users found that the robots are not user-friendly for programming methods/protocols (mean: 2.3).

Adoption of liquid handling robots in this laboratory faced initial challenges with programming and method development. However, after protocols were developed and trainings completed, the robots helped users to complete tasks efficiently and allowed researchers to focus on higher level tasks.

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ABSTRACT

The Effect of Education on Hypertension Knowledge and Management Among Parishioners in a Faith Based Setting

Hypertension (HTN) is a major risk factor for stroke, heart and kidney diseases, and increases morbidity and healthcare costs. Evidence has shown that HTN education can directly increase HTN knowledge and promote lifestyle behavior changes which can improve blood pressure control. Although evidence supports using faith-based settings to provide health education to better manage chronic conditions and prevent complications, HTN education is underutilized in this community setting. Using the Plan-Do-Study-Act model to guide the implementation of this evidence-based project, the study aimed to assess the effect of a HTN educational intervention, delivered in two 45- minute classroom sessions, on knowledge score, self-reported lifestyle behavior change (exercise and salt/sodium intake) and blood pressure measurements among parishioners in a community church. Blood pressure screening identified 56 eligible adults, 44 were enrolled, and 36 completed the study. Participants' knowledge scores, measured by the 14 item Hypertension Evaluation and Lifestyle Management (HELM) scale, and self-reported salt/sodium intake and physical activity behaviors were compared before and after the intervention. Blood pressure changes from baseline to two-week post-intervention were also compared. Results showed a significant increase in post-intervention knowledge scores, a significant increase in the average number of minutes participants exercised per week, a significant increase in the number of participants who self-reported watching or reducing their salt/sodium intake, and a significant decrease in average systolic BP from pre-intervention to two weeks post-intervention. These findings give insight into the practicality and effectiveness of healthcare professionals collaborating with faith-based leaders to provide education in faith-based settings to promote improved lifestyle behaviors and blood pressure management, can impact the health of parishioners, serves as a catalyst for spread into the community to reduce risks of life-threatening conditions, decrease healthcare costs, and supports population health beyond clinical walls.

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ABSTRACT

The Development, Implementation and Evaluation of an Evidence-Based Biohazard Training Program within a Pediatric Ambulatory Practice

Communicable disease(s) such as Ebola or Coronavirus can cause a catastrophic health crisis within the United States healthcare system, especially among the pediatric and elderly population. Lack of knowledge, skills and confidence among health care professionals in the pediatric setting regarding these infectious organisms can affect early identification, proper isolation, early treatment, and increased risk of a possible pandemic and/or fatalities.

The aim of this study was to develop, implement and evaluate an evidence-based biohazard training program-using the Identify, Isolate and Inform (3I) tool within a pediatric urgent care center to increase the staff's knowledge, skills and confidence in managing these high-risk patients.

This quality improvement project involved sixteen pediatric urgent care center staff members who took part in the biohazard-training program utilizing a pre and posttest via a modified Knowledge, Skills, Attitude (KAP) survey. An analysis of variance (ANOVA) was performed on the data collected.

A 70% knowledge (K) score, 96.9% attitude (A) score and 87.5% practice (P) score including a total KAP score of 84.8% were obtained at baseline with a p-value of 0.032 and a 56.2% confidence level. After the completion of the evidence-based biohazard-training program, a 10% increase in the categories of knowledge, practice and skills was found and maintained for 60-days post training with an increased confidence level of 74.5%.

An evidence-based biohazard-training program using the 3I tool is useful in the identification and management of communicable disease(s). The training program can be an effective preventative measure to minimize infection and prevent the spread of a contagion. Therefore, more research is needed with a larger sample size to determine its usefulness within a clinical setting.

Public Health

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ABSTRACT

Examining Risk Factors for Overweight/Obesity in Low Socioeconomic Status African American and Hispanic Children in the United States: A Scoping Review of the Literature

African American (AA) and Hispanic children growing up in the low socioeconomic status (SES) environment in the United States are disproportionately affected by childhood overweight/obesity. The aim of the scoping review was to explore the risk factors associated with childhood overweight/obesity in the low SES AA and Hispanic children in order to determine implications for future research.

CINAHL, PubMed, and Google Scholar databases were used to identify research articles addressing risk factors associated with childhood overweight/obesity in the low SES AA and Hispanic children. The following search terms were used: childhood obesity, risk factors, low SES, and race/ethnicity. After applying inclusion and exclusion criteria, a total of 15 studies were identified. Peer-reviewed research articles that included AA and/or Hispanic race/ethnicity and low SES were included in the review. Studies that did not specify any racial/ethnic group, studies that did not indicate SES, and studies outside the U.S. were excluded from the review.

Several studies (N=9) of the 15 identified in the scoping review documented similar social-ecological risk factors for childhood overweight/obesity among low SES AAs and Hispanics. Personal factors (N=6): increased rate of infant weight gain within the first year of life, consumption of sugar-sweetened beverages, and low fitness scores; and familial (N=3): maternal overweight or obesity, maternal depression, maternal control of infant feeding, and sedentary activity of parents were documented among both racial groups. One study reported the societal factor of neighborhood deprivation as contributing to overweight/obesity in AA and Hispanic children.

Among AA and Hispanics children, overweight/obesity is associated with common risk factors encompassing personal, familial, and societal domains. Future research should include interventions targeting the most frequently identified socio-ecological domain of personal factors targeted to reduce obesity in low SES AAs and Hispanic children. In addition, further investigation into other societal risk factors that may contribute to obesity in this population is warranted.

Public Health

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ABSTRACT

Alcohol Screening, Brief Intervention, and Referral to Treatment Protocol in the Emergency Department

The impact that results from inappropriate alcohol consumption poses challenges to public health. The rate of alcohol-related visits to Emergency Departments (ED) has increased, which has resulted in an increased annual cost of alcohol-related visits. ED serves as a common portal of entry into the healthcare system for many patients and offers a unique opportunity to impact drinking behaviors.

To increase the number of alcohol screenings and brief interventions when indicated to adult patients who visit the ED, and increase ED nurses' knowledge regarding alcohol misuse and indications for brief interventions.

An educational module was delivered through the hospital's E-learning management system. Ten multiple-choice pretest/post-test questions were administered to the ED nurses. A consecutive sample of ED patients, 18 years and older, over a 3-month period was used. A 3 single-item screening question tool was programmed into the ED electronic health record to detect alcohol use disorder. Patients with positive screening, a score above 7 were flagged to alert peer recovery coaches to provide brief intervention and referral to treatment.

Seventy-nine nurses, representing 91% of the total number of ED nurses, completed the educational module. A dependent sample t-test indicated a statistically significant gain in nurse's knowledge (t (78) = 15.91, p < .01). Screenings were conducted with 11,897 of 13,529 eligible patients, an 87% screening rate.

The findings from this study were encouraging to support the effect of an educational module on ED nurses' knowledge, and that an SBIRT procedure can impact alcohol use disorder through early identification.

Public Health

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ABSTRACT

Implementing A Digital Imaging Protocol Using Tissue Analytics Platform In A Level I Trauma Center Hospital To Identify Poas And Improve Documentation And Staging Of Pus

More than 2.5 million people develop pressure ulcers (PUs) annually. PUs cost the U.S. $9.1-11.6 billion per year. There are more than 17,000 lawsuits annually due to PUs (Berlowitz, 2011). Per 2008 CMS policy, hospitals experience negative reimbursements for hospital-acquired pressure ulcers (HAPUs), defined as any ulcer noted at 24 or more hours of hospital admission (CMS, 2015). Documentation of a PU must indicate if it is present on admission, and include accurate stages and progression of treatment to improve patient outcomes and to decrease liability.

To use Digital Imaging (DI) along with the standard PU prevention protocol and compare to using the standard protocol alone two months pre-intervention and two months post-intervention. The objectives of this study were to (1) Improve identification of PUs that are present on admission (2) Increase accuracy of PU staging and (3) Improve documentation of PUs.

Data was analyzed using SPSS version 26 for Windows (IBM Corp., Armonk, NY). Frequency tables and descriptive statistics were used to summarize the demographics of the participants, documentation of the stages of POA and HAPUs, Braden scores, and AHRQ staff attitudes survey (pre-intervention only).

There were 55 participants (preN = 23, postN = 32). The majority of the participants in the pre-intervention were male (82.6%) black (52.2%) and aged 66.21 (SD=11.07). Half of the participants in the post-intervention were male (50.0%); most were black (59.4%) and age 61.88 (SD=17.20).

DI with the standard protocol did not significantly improve the identification rate of POAs nor documentation of PU staging. These factors depended more on patient acuity. However, documented difference in staging along with improved quality of documentation and decreased staff documentation time was noticed.

Quality Improvement

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Michael Knight

ABSTRACT

Increasing Naloxone Prescribing in an Outpatient Setting

Prescription opioid overdose is a major concern in the United States. The overdose rate has increased six times since 1999, killing more than 47 thousand people in 2017; 36% of which involved prescription opioids. Take home naloxone has been shown to save lives. To combat this epidemic, CDC guidelines recommend prescribing naloxone to any person prescribed opioid doses of 50 milligram morphine equivalents, concomitant diagnosis of opioid abuse or overdose, or benzodiazepine use.

A quality improvement initiative aimed to increase the number of outpatient naloxone prescriptions by 20% in Department of Internal Medicine at the George Washington University Medical Faculty Associates.

Prior to study, internal medicine providers were sent a survey assessing knowledge of naloxone recommendations for patients prescribed opioids. Opioid and naloxone prescribing pattern data was extracted from the electronic medical record (EMR) prior to study and throughout PDSA cycles. Patients included all those seen by providers in the Department of Internal Medicine within the past 12 months, regardless of who prescribed the opioids. For the initial intervention, in PDSA cycle one, internal medicine providers were educated about CDC naloxone prescribing guidelines through email and announcements. At two months, PDSA cycle two began. Posters were developed and placed in the internal medicine provider work rooms. Posters included naloxone recommendations for patients on prescription opioids, how to prescribe naloxone in the EMR, and pharmacy and insurance information. Four months from intervention onset, PDSA Cycle 3 began. Patient education pamphlets were distributed in clinic to all patients with opioids recorded on the medication list, prior to provider encounter.

Prior to the study, naloxone was prescribed to only 1 patient with history of opioid abuse and 3 patients prescribed 50MME/day. Patients prescribed opioids with history of opioid abuse (n= 44), any substance abuse (n=77), prescribed 50MME/day (n=68), and prescribed benzodiazepines (n=221). Initial provider awareness of guidelines was limited. After PDSA cycle one, four new patients were prescribed Narcan. After PDSA cycle two, five new patients were prescribed Narcan.

Quality Improvement

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ABSTRACT

Increasing the Utilization of an Online Patient Portal ("Follow My Health") to Facilitate Physician-Patient Communication

It has been previously demonstrated that the utilization of online patient portals has the potential to augment physician-patient communication (1-3), therefore we believe that increasing utilization of these communication modalities is a worthwhile endeavor to help physicians meet the needs of their patients in an efficient manner. We have conducted a quality improvement (QI) project that sought to increase the number of patients registered for "Follow My Health" (FMH), the online patient portal currently utilized by the MFA, our large urban primary care and subspecialty medical practice. We measured the percentage of patients, who were seen by PGY-1 and -2 categorical internal medicine residents, that were enrolled in FMH over the course of 4 PDSA cycles each lasting 1 week. The four cycles consisted of (1) collecting baseline data (2) posting written reminders for providers to discuss FMH enrollment with patients on the computers of individual exam rooms (3) placing institution-created flyers in chart holders outside of exam rooms containing FMH enrollment instructions (to be distributed to patients at the time of their visit) (4) placing additional copies of this flyer at the check-out desk for patients to take at the conclusion of their appointment. We found that at the conclusion of the first PDSA cycle (ie study baseline), 41% of patient seen by both PGY-1 and PGY-2 residents were registered for FMH. Our goal was to increase this number for both groups of providers to 60% at the conclusion of the project. Following the fourth and final PDSA cycle, the PGY-1 class increased their enrollment percentage to 51% and the PGY-2 class increased their enrollment percentage to 48%, both falling short of the 60% goal. More effective methods of encouraging patients to register for FMH must be sought, including but not limited to involvement of ancillary staff as well as patient education.

Quality Improvement

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ABSTRACT

The Utility of Bandemia in the Prognostication of Sepsis

Bandemia, defined as a band count >10%, is highly indicative of underlying infection and is increasingly being used in the ED and the ICU for identification of sepsis. Bandemia has been linked to worse outcomes, but its trend in the hospital has not been studied well. In this retrospective study, our objective is to assess the severity of bandemia at 0 and 72 hours among patients admitted to the ICU for sepsis or septic shock, and to evaluate if there is a direct correlation between increasing bandemia and clinical deterioration among these patients.Methods:

We performed a retrospective chart review of patients admitted to our tertiary care ICU for sepsis or septic shock from the ED. Patients were excluded if their bandemia was due to etiologies other than sepsis. We recorded the band counts, SOFA scores, vasopressor use, and the clinical course of 134 patients included in our study at 0 and 72 hours after admission. Worsening clinical course was defined as increasing SOFA scores or the initiation and continuation of vasopressor support at 72 hours. Patients were analyzed based on SOFA trends (SG=SOFA group) and vasopressor trends (VG=vasopressor group). They were distributed among groups 1-4 SG based on resolving, steady-state or worsening SOFA scores, and groups 1-4 VG based on improving, steady-state or worsening vasopressor requirement.

Among the 134 patients included for analysis, the average SOFA score on admission was 6. Based on SOFA scores and vasopressor trends between hour 0 and hour 72, there was a statistically significant improvement in bandemia for patients in Group 1 (Range -10.3 ± 15.3, Mean -6) with resolving sepsis (P<0.0001 SG, P<0.0001 VG) and a statistically significant worsening in bandemia (Range 10.1 ± 6.4, Mean 7) for patients in Group 3 with worsening sepsis (P=0.0001 SG, P=0.0007 VG).

This data suggests that the clearance of bandemia can be used as a marker of clinical improvement in sepsis. It also shows that worsening bandemia is predictive of deteriorating clinical status and higher mortality. The trend of bandemia in the ICU can, therefore, be used to guide the safe de-escalation of antibiotic therapy in the ICU, and potentially decrease the total duration of antibiotic use.

Quality Improvement

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Michael Knight

ABSTRACT

Improvement of Inpatient Naloxone Prescribing at George Washington University Hospital

Opioid abuse resulting in death has been affecting the lives of Americans for decades. In 2017 alone, there was a reported 47,000 deaths contributed to opioid overdoses. In 2017, 1261 people visited the emergency department for opioid related complaints and suffered a mortality rate of thirty-three percent. Naloxone, a non-selective competitive opioid receptor antagonist, is capable of reversing the life-threatening effects of respiratory depression that lead to mortality. However, there is a persistent lack of prescriptions being dispensed across the nation. The CDC has published guidelines to identifying those most at risk for opioid overdose who will benefit most from Naloxone. Prescribing at George Washington University Hospital was suspected to be low with substantial potential benefit to quality improvement interventions aimed at naloxone prescribing to prevent opioid related overdose. The goal of this Quality Improvement Project is to increase the overall number of Naloxone prescriptions at George Washington University Hospital by 20%. Initial data was gathered during a run-in period to analyzed naloxone prescriptions for those considered at-risk. Through a series of quality improvement interventions, the authors sought to increase awareness of prescribing guidelines and incentives to prescribe. The first intervention was through an email to the residents of the internal medicine department and verbal announcements during conferences. The second was implementing posters in team rooms educating team members on the CDC guidelines. The third cycle was an improvement of poster visibility and expansion of the second cycle intervention to psychiatric resident team rooms as well as advertisement campaign aimed to increase awareness and the physician sense of responsibility coupled with outreach to attending physicians. Results were gathered on a quarterly basis and organized into a run chart. Data from the run-in period indicates a baseline prescribing rate of naloxone for eligible patients of 1.4%. Initial data obtained in the 8 weeks after the first educational campaign showed an increase of absolute naloxone prescriptions by 200% compared to the 8 weeks preceding the first PDSA cycle. This resulted in a subtle increase of the prescribing rate to 1.5%, a relative increase of 7%. Initial data indicates that educational campaigns targeting residents responsible for naloxone prescribing is effective in increasing naloxone prescriptions for patients meeting the CDC prescribing criteria.

Quality Improvement

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ABSTRACT

Increasing 23-Valent Pneumococcal Polysaccharide (PPSV23) Vaccination in Pediatric HIV Patients – Ryan White Program Experience

The American Academy of Pediatrics recommends all children living with HIV infection receive 23-valent pneumococcal polysaccharide vaccine (PPSV23) after receiving the 13-valent pneumococcal conjugate (PCV13) vaccine series. Immunizations are typically administered through primary care provider (PCP) services, rather than subspecialty clinics. In 2015, as part of an initial quality improvement project (QIP), Children's National Hospital (CNH) Special Immunology Services (SIS) noted only 8.7% of eligible pediatric HIV patients had received their PPSV23 immunization. This ongoing QIP aimed to increase the rate of PPSV23 vaccination among SIS patients.

The specific aim was to increase the percentage of SIS patients who have received their first PPSV23 vaccination from 8.7% to 50% by June 2020.

A key driver diagram identified specific barriers to PPSV23 vaccination, including incomplete or unavailable immunization records for SIS patients who received their primary care elsewhere. Using the team-based Model for Improvement, iterative Plan-Do-Study-Act (PDSA) cycles included: 1) acquiring immunization records from various external and internal sources; 2) identifying eligible patients before clinic visits; 3) administering PCV13 and PPSV23 immunizations in SIS clinic instead of relying on PCPs. Up-to-date immunization records of patients enrolled in care at SIS clinic were obtained by Patient Care Navigators searching local immunization registries and contacting PCPs. Once immunization records were established, patients eligible for PCV13 or PPSV23 immunization were identified during multidisciplinary weekly team meetings. During routine clinic visits, SIS nursing staff administered vaccines. Nursing staff ensured documentation was added to the patient's chart, sent to registries and PCPs, and recorded in an internal spreadsheet.

From 2015 to February 2020, the PPSV23 immunization rate increased four-fold from 8.7% to 40.7%.

Expanding the clinic's dedicated staff to obtain immunization records and administer both PCV13 and PPSV23 led to a dramatic increase in the percent of SIS patients who received their initial PPSV23 vaccination. These findings, in the setting of the CNH SIS subspecialty clinic in a tertiary care center in the major metropolitan setting of DC, suggest that the expansion of in-house vaccination capacity and the prioritization of obtaining immunization records is a highly effective avenue to improving vaccination rates among children and adolescents living with HIV.

Quality Improvement

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ABSTRACT

Utilizing the CFIR Framework to Analyze BarriersaAnd Facilitators as Perceived by Clinical Teams Implementing Supportive Care for People with ESKD

Among seriously ill patients, those with chronic kidney disease (CKD) and end-stage kidney disease (ESKD) often receive the worst end-of-life care. 45% of dialysis patients die in the hospital, often after high intensity care and invasive procedures. The Pathways Project, funded by the Gordon and Betty Moore Foundation, and housed at GWU in the School of Nursing, in partnership with West Virginia University is currently implementing a national collaborative to implement best practices in kidney supportive care. Utilizing the Institute for Healthcare Improvement (IHI) Breakthrough Series' healthcare collaborative, eleven dialysis centers and three CKD clinics around the country are working to develop and implement these best practices. The IHI brings change teams from each site together to collaborate and learn from faculty and each other during "learning sessions". One of the hallmark features of the collaboration is the storyboard session, where each change team shares their experience implementing the intervention. The storyboard shares their problem, aim, test of change, as well as results, analysis and lessons learned from their process. Teams then engage in a walk around poster session to discuss and discover the lessons learned from other change teams within the Pathways Project.

This poster evaluates the content shared within these storyboards to determine the similarities and differences of the change experience across change teams. Two members of the Pathways Project (the authors) conducted qualitative analysis of the content of the storyboards submitted by the teams. The analysis revealed the key barriers and facilitators that the change teams shared, as well as unique contextual features that promoted or inhibited success according to the constructs outlined in the consolidated framework for implementation research (CFIR) (Damschroeder et al., 2009). This analysis has implications for the teams moving into the next phase of the IHI learning collaborative. Additionally, the research team will use this knowledge to further the successful implementation of the current teams, and in future iterations of implementing supportive kidney care in dialysis centers and CKD clinics.

Quality Improvement

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ABSTRACT

Active Learning - An Effective Teaching Modality that Improves Audience Engagement

This project was designed to evaluate if the use of active learning techniques impacts evaluations of continuing medical education (CME). We defined active learning as any instructional method that engages the learner in the educational process. In CME active learning techniques have not been well studied. Information on how to use active learning was provided to all Grand Rounds speakers during the 2018-2019 academic year. Each session was rated as having implemented active learning fully, partially or not at all. Evaluations using a 5 point Likert scale were completed at the end of each session by students, residents and faculty. Of the 27 Grand Rounds included in the study, 8 fully implemented active learning techniques, 10 partially implemented and 9 did not implement at all. The most common technique used by the speaker was audience response. Other commonly used techniques were think-pair-share and case discussions. A total of 511 evaluations were collected. The sessions that fully or partially implemented active learning had higher scores on the evaluations in response to questions on efficacy of teaching methods, understanding the topic and overall effectiveness of the presentation when compared to sessions that did not implement active learning at all using the Mann Whitney U test ($p < 0.05$). There were no differences in perceived expertise of the speaker($p > 0.05$).

The use of active learning techniques is viewed favorably by those attending Grand Rounds. Institutions should use active techniques to improve satisfaction with CME.

Quality Improvement

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ABSTRACT

Telemetry: Too Much of a Good Thing?

Telemetry involves the use of electrodes to actively monitor patients in the inpatient setting for adverse cardiac events. Telemetry can be useful in decreasing morbidity and mortality by alerting clinicians to arrhythmias leading to quicker personnel response to the bedside. However, telemetry use is costly, and appropriate stewardship is important for the delivery of high value healthcare. Telemetry monitoring can increase the price of hospitalizations by hundreds of dollars per day. This cost can lead to poor allocation of hospital resources which could be better utilized in alternative ways. We performed a quality improvement project with a goal of decreasing telemetry usage by the internal medicine service by 10%. This was done by assessing internal medicine residents understanding of appropriate telemetry indications, and interventions directed towards residents on internal medicine wards teams. These interventions included the use of e-mail, text messaging, and educational flyers aimed towards residents on the internal medicine wards service. We tracked the trend of active telemetry orders on inpatients both before and after each intervention. Of note, concomitant hospital interventions were implemented that altered the process of ordering telemetry via the electronic medical record. During the study timeframe, telemetry utilization was successfully reduced by 10% on the internal medicine service. This suggests that education interventions are a promising avenue to optimizing telemetry usage.

Quality Improvement

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ABSTRACT

Pattern of Resource Utilization and Hospital Admissions Among Syncope-Related Visits to US Emergency Departments

Syncope-related visits to Emergency Departments (ED) utilize significant hospital resources. In this study, we examine demographics, resource-allocation, and hospitalization trends in syncope-related visits to U.S. EDs over 11-years.

Data from adults 18 years and older from the 2005-15 National Hospital Ambulatory Medical Care Survey (NHAMCS) were analyzed. Reason for visit codes were used to identify ED visits for syncope. Non-syncope visits were the comparator. Bivariate statistical analyses were used to assess ED demographics, resource allocation, and admission trends in both groups.

From 2005-15, there were 15.5 million syncope-related ED visits in the United States. Mean patient age was 54 years, 59% were female, and 79% were white. Syncope visits commonly involved a head CT (33.7%, 95% CI 31.1-36.5 $p<0.001$) and EKG (72.2%, 69.9-74.4 $p<0.001$). Syncope visits among older adults were more likely to involve a head CT with ages 61-80 (41.9% 95% CI 36.4-47.7 $p<0.001$) and over 80 (40.2%, 95% CI 33.8-47.1 $p<0.001$). A total of 25.5% (95% CI 23.5-27.6 $p<0.001$) of syncope ED visits were admitted. The percentage of syncope-related visits admitted peaked in 2005 at 31.45%, and were lowest in 2014 (16.2%). There were 49.4% (95% CI 46.1-52.7 $p<0.001$) that were transported to the ED by ambulance. Compared to non-syncope ED visits, syncope visits were more likely to have a history of coronary artery disease (11.7% 95% CI 8.4-16.0 $p<0.001$), hypertension (36.1%, 95% CI 29.7-43.1 $p<0.001$). They were also more likely to be administered IV fluids (54.3% 95% CI 51.4-57.1 $p<0.001$) and reported a lower average pain-scale at triage (5.5 95% CI 5.3-5.8 $p<0.001$). The three most common diagnosis reported were fainting, vertigo, and general weakness.

Syncope-related ED visits represent a significant burden to the ED and hospital resources. A disproportionate amount of these visits received a head CT or were subsequently admitted to the hospital. Given the high number of syncope-related ED visits, low diagnostic value of head CT scans, and rate of admission with nonspecific discharge diagnoses, there are several areas for improvement in cost reduction and efficiency in treating patients presenting with syncope.

Quality Improvement

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ABSTRACT

The Use of Active Learning to Improve Recall, and Utilization of Information from OBGYN Grand Rounds

This project was designed to evaluate if the use of active learning techniques improves recall and utilization of information taught during Grand Rounds.

We defined active learning is any instructional method that engages the learner in the educational process. Active learning retention in a variety of settings, but in CME, has not been well studied. Information on how to use active learning was provided to all Grand Rounds speakers during the 2018-2019 academic year. Each session was rated as having implemented active learning fully, partially or not at all. 2 weeks later, attendees were asked to write down any information they remembered from the session as well as any information that they had already used in practice. The number of items recalled or used was recorded. Data was analyzed using a Mann-Whitney U test. 27 Grand Rounds sessions were included in the study. 8 speakers fully implemented active learning and 10 partially implemented active learning. Participants recalled significantly more items when the speaker fully implemented active learning when compared to speakers who did not use any active learning techniques (2.3 vs 1.9 items with p=0.004). Participants utilized a greater number of items from the session when the speaker used any active learning technique (full or partial implementation) as compared to no active learning (p<0.05). Utilizing active learning during Grand Rounds promotes retention and utilization. We suggest using active learning techniques to improve uptake of new information.

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ABSTRACT

Improving the Interventional Radiology Medical Student Curriculum through a Clinically Centered Rotation Experience

Due to the constraints of time, standardized workflow, and other administrative tasks on modern academic medicine wards, often patients may be left with significant questions or a poor understanding of procedures they will undergo. Often there is not an adequate addressal of these points during pre-procedural consent and patient education. As interventional radiology is a relatively new medical specialty, many patients do not have a good understanding of the field. Often IRs work in the inpatient setting and patients do not have exposure to their work until their services are needed. As IR grows as a field, it is shifting to becoming a more clinically oriented specialty that has greater patient interaction and direct management of patients. In order to best serve the public and patients in general, it is important that there is greater education provided to the public on what services IR can provide and what treatments are available. At the same time, it is critical to ensure that the next generation of IR providers are adequately trained to become well rounded clinicians rather than a simple proceduralist. Our project aims to learn more about the public's knowledge of IR, educate the public about IR, and educate students and improve their training in becoming clinicians.

Quality Improvement

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ABSTRACT

Extraoral Bitter Taste Receptors in the Mammalian Liver

Bitter taste, is thought to guide organisms to avoid harmful toxins, and thus critical to survival. The sensors for bitter compounds are bitter taste receptors (TAS2Rs), a class of G protein-coupled receptors (GPCRs) originally identified in the taste bud ligand. The expression of T2Rs have been found in several extra oral systems, including the liver, brain, and GI system. This study seeks to isolate RNA from C57B/6 livers, synthesize cDNA, use TaqMan array qPCR for 10 TRs expressed in the liver, confirm the presence of Tas 2R via RT-PCR, clone full-length Tas2R into mammalian expression vector, confirm the surface expression of transfected Tas2r108 and Tas2r135. Overall we hope to determine physiological ligands for receptors for via calcium assay and elucidate function of hepatic sensory receptors. Furthermore, we will begin calcium assay to test any published ligands to detect intracellular calcium signaling. These findings raise the question of the biological function of these taste receptors, if any, in extra-oral cells. The liver is the largest metabolic organ in the body and participates in maintaining homeostasis in many ways including regulating blood composition, bile & cholesterol production, and drug metabolism. As such, the liver is primed to take advantage of these sensory receptors. In conclusion, we found that Tas2r135 and Tas2r108 have been localized in the liver and traffic to the cell surface. In addition, calcium assay studies are in process of assessing knowling ligands and in future more physiological ligands will be explored. In the future, other ligands will be explored and elucidate the function of hepatic sensory receptors.

Quality Improvement

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ABSTRACT

Daily Physician – Nurse Huddles Improve Nurse Satisfaction with Communication and Perceived Awareness of Unstable Patients

Nurses and physicians each utilize evidence-based methods for identifying clinically decompensating patients, however this data is not always conveyed or accessible to all team members. We aimed to improve nurse satisfaction with physician-nurse communications about patient clinical status. The first of three PDSA cycles attempted to identify unstable patients by modified early-warning scores (MEWS) charted by nurses. We found that physicians are unable to view MEWS in real-time. The second cycle evaluated utilization of Rapid Response nurses as mediators. This nurse responds to elevated MEWS or requests for evaluation, generating a list of "unstable" patients. Though nurses and physicians can communicate with the Rapid Response nurse, the list of "unstable" patients is not accessible to either. In the third cycle, residents and nurses agreed to daily, structured team-based rounds. The senior resident of a medicine team met with the charge every morning after the shift-change. Together, they identified patients on the team census as "unstable" or "watcher". The resident then met with the bedside nurse assigned to each patient. Pre- and post-intervention surveys assessed nurse satisfaction with physician-nurse communications and nurse perceptions of physician/ nurse awareness of unstable or ill patients. Nurses rated overall satisfaction with communication with housestaff physicians on a scale of 1-5 (1- Very Unsatisfied; 5- Very Satisfied) in 14 pre- and post-intervention surveys at 2.21 and 3.07, respectively (p < 0.005). Nurses rated their awareness of housestaff concern about unstable patients on a scale of 1-5 (1- Almost Never; 5- Almost Always) pre- and post-intervention at 1.79 and 2.79, respectively (p = 0.0001). Nurses rated housestaff awareness of nurse concern about unstable patients on a scale from 1-5 pre- and post-intervention at 2.29 and 3.43, respectively (p < 0.005). There were no significant differences for how often nurses recognized when a patient was "unstable" as self-rated on a scale of 1-5 (2.64, 3.07; p = 0.162), nor for how often nurses included whether a patient was "unstable" in verbal signout (2.93, 3.50; p = 0.068). Interdisciplinary team huddles facilitate collaboration and improve situational awareness for a cohesive, anticipatory response to critical situations. In our study, team huddles improved nurse satisfaction with communication between team members.

Rehabilitation and Recovery

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ABSTRACT

Rehabilitation Interventions for Adults with Disorders of Consciousness Following a Brain Injury: A Scoping Review

Practice guidelines for patients in disordered states of consciousness (DoC) following a traumatic brain injury (TBI) recommend rehabilitation services. Therapists report 'trying things' when selecting interventions to facilitate recovery of consciousness (RoC) for these patients. The purpose of this study is to review the evidence to support rehabilitation interventions utilized to facilitate RoC for patients following a TBI. We conducted a PRISMA systematic review of rehabilitation interventions to facilitate RoC following a TBI.3 A research librarian developed the search strategy. We searched Cochrane, Embase, PsycInfo, Scopus, and PubMed for articles from 2015-2019. Inclusion criteria: English language, a rehabilitation intervention, and one adult with DoC following a TBI. Two authors conducted the title, abstract, and full text review. Once the manuscript met eligibility criteria, data were extracted, and methodological quality assessment was conducted. A content analysis of the included manuscripts explored the types of rehabilitation interventions. We screened 3,851 manuscripts and 28 met inclusion criteria. Of the 28 manuscripts, 13 were RCTs, six non-RCTs, three case control studies, two cohort studies, and four case series. Of the 25 manuscripts evaluated for methodological quality: 1 was high, 21 were acceptable, 1 was low, and 1 was unacceptable. Content analysis identified rehabilitation interventions as either general (n=3) or specific (n=25). General interventions were multi-disciplinary and provided a broad description of what was provided to the patient but insufficient detail to enable replication. Specific interventions included preparatory stimulation (n=14), positioning (n=2), or sensory stimulation (n=9). Preparatory interventions include electrical stimulation such as transcranial direct current stimulation (tDCS). Positioning interventions involved the use of a tilt table. The sensory stimulation programs were either multi-component or focused on auditory stimulation (n=6) using familiar voices or music. Each intervention was coded regarding the personal relevance of content to the patient. 29% of the manuscripts included personally relevant content using familiar voices, pictures, or music. One preparatory intervention manuscript included personally relevant content with the family saying the patient's name.

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ABSTRACT

What's Fishy About Blockchain? Adoptability of Blockchain in Food Industry Supply Chains

When tracking down the root cause of a food-borne illness in complex supply chains, time is of the essence. While traditional tracing methods usually take weeks to locate the specific part of a supply chain contributing to an outbreak, the emerging technology blockchain promises to revolutionize traceability in food industry supply chains. Blockchain technology utilizes a system of connected computers to create a secure and unalterable record of financial transactions, allowing for reliable tracking of suppliers and distributors within a chain. In the case of an outbreak, access to this record could lessen tracking times from a few weeks to a few days. However, in recent years few organizations have moved to implement this technology, despite its potential and initial media hype. This research aims to explore the question of what factors influence companies to adopt blockchain in food industry supply chains. This qualitative case study utilized the Unified Theory of Acceptance and Use of Technology (UTAUT) model of technology adoption as a framework for understanding the correlation between the variable facilitating conditions (i.e. technical resources and organizational support) and blockchain adoption in food industry supply chains. A content code analysis of media articles and press releases regarding the seafood supplier, Raw Seafoods' recent partnership with IBM FoodTrust blockchain technology was used to identify the presence of the facilitating conditions technical resources and organizational support. The content code analysis searched for the presence of key words indicating technical resources and organizational support that suggested the presence of facilitating conditions as a key determinant of Raw Seafoods' blockchain adoption. Analysis of the partnership between Raw Seafoods and IBM FoodTrust revealed three themes that suggest a likelihood of blockchain adoption: espoused values of sustainability and collaboration, trust in technical infrastructure to mitigate risk, and awareness of changing consumer values. Additionally, the content code analysis suggested that blockchain is now entering the "slope of enlightenment" phase of Gartner's Technology Hype Cycle, providing further environmental context for trends in blockchain adoption. This phase indicates that practical applications of blockchain technology are now beginning to be understood and implemented among a few companies. The implications of this research are a better understanding of the ways in which technology can contribute to a safer and more sustainable food system, as well as ways organizations in the food industry can best embrace technological change in the coming decades.

Social Sciences

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Christina Gee

ABSTRACT

Father Involvement and Depressive Symptoms in a Diverse, Low-Income Sample of Unmarried Mothers

Maternal depression has been shown to have a variety of consequences for child and maternal health. While research demonstrates that supportive relationships with fathers ameliorates maternal stress and depression, these studies lack a diverse sample and focus primarily on frequency of father involvement (FI) and neglect other factors such as maternal preference for change in the frequency of FI. The present study examines the associations between maternal depressive symptoms, frequency, satisfaction, and preference for change in frequency of FI in a low-income, primarily minority sample of unmarried mothers. We hypothesized that: H1) lack of satisfaction with FI would be associated with higher levels of maternal depression; and H2) frequency of FI and preference for change in FI would moderate this relationship, in that higher levels of FI will positively impact maternal depressive symptoms. Participants consisted of 106 low-income mothers (77% African American) with young children. The majority (65%) were never married, 6% were divorced, and 29% were not married but in a steady, committed relationship with their child's biological father or with another person. Participants completed self-report measures that assessed frequency, satisfaction, and preference to change FI, as well as depressive symptoms.Hypothesis 1 was not supported. A simple linear regression indicated a non-significant, weak, negative relationship between maternal depression and satisfaction with FI. Hypothesis 2 was partially supported. A Hayes PROCESS macro indicated that maternal desire for change in FI significantly moderated the relationship between maternal satisfaction with FI and maternal depressive symptoms, in that when mothers were less satisfied with FI and desired an increase in frequency of FI, they reported more depressive symptoms. However, frequency of FI did not significantly moderate the relationship between maternal satisfaction with FI and maternal depressive symptoms. Maternal satisfaction with the relationship with their child's father may serve to alleviate some of their depressive symptoms. However, when mothers are not satisfied and desire an increase in FI, the stress associated with this lack of satisfaction may exasperate these symptoms. These results suggest that future studies should evaluate maternal perception of FI when looking at maternal depressive symptoms, especially when trying to meet the needs of low-income populations who may have difficulty accessing resources, such as quality child care, that could alleviate some of the stress that comes with the dissatisfaction of support received from their child's father.

Social Sciences

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ABSTRACT

Creativity in Confinement: A Multiple-Case Study on Self Determination Theory and the Open Studio Model in a Juvenile Detention Facility

The three innate psychological needs according to Ryan and Deci's (2000) Self Determination Theory (SDT)—competence, autonomy, and relatedness—all become inherently limited once an adolescent is detained within a juvenile facility. Both spoken and unspoken rules maintained within such an institution yield a culture of submission, assimilation, and isolation, thus subjugating residents to limited opportunities for attaining the needs conducive to optimal psychological well-being. The present case study explores the implications of access to an open-art studio in a facility where neither art class nor art therapy is currently offered. As part of a weeklong, facility-wide enrichment program, all residents of the detention facility were offered 45 minutes of daily open art studio with a visiting art therapist-in-training. The adolescents (N = 28) met in groups of 4-7 participants and received intentional time to look at and discuss artwork made by self-taught incarcerated artists, receive instruction for a wide variety of materials, and pursue individual projects. This case study highlights the experience of ten participating adolescents. Artwork created during open studio sessions was categorized by the following recurring themes: (1) experimentation with new materials/mastery of a familiar materials, (2) depiction of a pleasant or comforting scene, (3) expression of positive aspects of self, and (4) commemoration of a deceased loved one. These themes suggest that when provided adequate time, resources, and support, the desire for competence, autonomy, and relatedness are spontaneously expressed through art-making. Implications of this case study provide support for the open-studio framework in enhancing psychological well-being.

Social Sciences

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ABSTRACT

National Service: Exploring the Origins and Evolution of a National Movement.

In his seminal work, Democracy in America, Alexis de Tocqueville (1838) noted that when Americans have an idea they "want to produce in the world, they seek each other out; and when they have found each other, they unite." Tocqueville's observations identified a unique civic culture rooted in an ethos of volunteerism and civic engagement. Throughout the country's history, leaders including politicians, educators, philanthropists, and non-profit founders independently fostered civic culture in their local communities but also on a larger, national scale. This began with William James' "Moral Equivalent of War" progressing through Franklin Delano Roosevelt's Civilian Conservation Corps, and John F. Kennedy's Peace Corps. At the end of the 20th century, service leaders drew inspiration from such programs to build a movement, which resulted in the Corporation for National and Community Service (CNCS). This formal establishment was a pivotal moment in American history. Yet, never before has any effort been made to preserve the stories of these leaders. Hence, the purpose of this study is to gather oral histories from significant leaders of the national service movement to understand the origin of national service as it is recognized today by the programs of the CNCS. The methodology of oral histories allows participants to share their unique experiences building national service. To date, 12 leaders have provided oral histories. After transcribing the oral histories verbatim, the researchers employed the constant comparative method of data analysis to identify emergent themes. One of the most significant findings is that due to external constraints such as inadequate federal funding, has limited national service's growth and it's potential remains unrealized. The findings from this study offer implications for future policies, organizational development theories, public private partnership, and civic and social well-being of our communities. This study's findings will be shared with the National Archives on National Service to inform, educate, and inspire the general public and current national leaders of the significance of national service.

Social Sciences

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Daina Eglitis

ABSTRACT

Sociodynamics: the Erotic as Entropy in a Colonial Capitalist System

Audre Lorde's Use of the Erotic as Power has provided a foundation for many black feminist, queer, and indigenous scholars to explore the erotic as a source of counter hegemonic power. My research argues that the second law of thermodynamics, or the predictable behavior of spontaneous reactions and chaotic energy, can provide a framework for theorizing of the erotic as a replenishing and accessible source of power. I operationalized this theory and apply it as an observational lens to Kara Walker's A Subtlety, or The Marvelous Sugar Baby to illustrate the utility of the entropic erotic as a tool for decolonial anticapitalist analysis of art.

My methodology required outlining key vocabulary and concepts integral to understanding entropy within in the paradigm of physics and the erotic within the paradigm of black feminist, queer, and indigenous theory. I then mapped the two paradigms on top of each other to reveal parallel observations of the behavioral tendencies of entropy and the erotic. These similarities were operationalized to develop overarching rules and concepts informing the entropic nature of the erotic. I then applied these operationalized concepts to an analysis of A Subtlety, or The Marvelous Sugar Baby to illustrate the utility of the entropic erotic as a tool for decolonial observations.

Both the predetermined loss of heat in an entropic reaction and the reclamation of the erotic as social power are labelled chaotic because they symbolize systems which cannot be controlled in colonial capitalist systems of science and society. I found that the concept of degrees of freedom, or the probability of possible outcomes utilized in physics to gauge a system's entropy, was central to connecting entropy and the erotic. The entropic power of the erotic stems from its untapped and unlimited potential. My observation of the erotic in queer, indigenous and black feminist literature and art indicates that the erotic has a significantly high number of degrees of freedom, comparable to the power affiliated with positional privilege.

Social Sciences

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ABSTRACT

A Time Series Analysis of Health Care Expenditure and Economic Growth in the United States

I study the relationship between healthcare expenditure and economic growth in the United States over the last several decades. I used time series data from the Federal Reserve Economic Database, the Organization for Economic Cooperation and Development, and the online publication Our World in Data that spans from the year 1970 to 2016. The time series analysis consists of a cointegration test to estimate the existence of a long-run relationship, as well as the estimation of a vector autoregressive model and Granger causality test. I find that HCE and GDP are cointegrated, and there exists bidirectional Granger causality between the two variables.

Social Sciences

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ABSTRACT

The Effect of the Opioid Epidemic on Labor Force Participation: A Study in Causality

In 1996, the FDA marked oxycodone under the brand name OxyContin as a nonaddictive substance and released the opioid-based prescription pain medication to the market. Despite the FDA's designation in 1996, opioids are extremely addictive. Today, the United States is gripped by an opioid epidemic. This work is inspired by the conclusions drawn in "Where Have All the Workers Gone? An Inquiry Into the Decline of the U.S. Labor Force Participation Rate" (2017) by the late Alan B. Krueger, James Madison Professor of Political Economy at Princeton University. One of the likely consequences of the epidemic is a decline in the labor force participation rate, or the percentage of the working age population that is actively seeking work. This paper contributes an instrumental variables regression and the Princeton Pain Survey II: a survey of nonparticipant women's subjective well-being and analgesic use. This study therefore investigates the causal influence of the opioid epidemic on labor force participation and strongly considers the influence on female participation.

Social Sciences

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ABSTRACT

Battle of the Tribes: Study of Metacognition as Explanation for Media Selection Patterns and Political Polarization in the United States

In an age of information overload, there is a notable lack of exploration with regard to American's news consumption habits across traditional and social media platforms. Moreover, the psychological effects on perception via these mediums in the twenty-first century as they pertain to political polarization remain largely unknown. This body of research aims to bridge the gaps that currently exist between citizens and the influence that news-media holds concerning perception of political, current, and governmental affairs—as well as suggested methodology to potentially remedy these faults. Compared with existing bodies of research, this topic is virtually undiscovered. Integrated with the application of cognitive and psychological theories tied to media consumption habits and opinion formation, this paper will tour the interstice between existing studies and attempt to unearth new connections between psychology, metacognition, and political self-efficacy that may lay the much needed foundation for mindful civil discourse.

Social Sciences

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ABSTRACT

Increasing Energy Security of High Voltage Transformer Substations: Policy Solutions to High-Impact, Low-Frequency Physical Attacks and Resiliency of HVTS

High voltage (HV) transformers make up only 3% of transformers, yet carry nearly 70% of the grid's electricity. This makes the U.S.'s ~2,100 HV transformers a vital chokepoint in our current grid and an energy security risk. There are several severe energy security risks already at play. Only 15% of the nation's large power transformers are made within the US; the rest are imported. There is a potential for other governments to withhold this vital piece of infrastructure when it is needed. There is little security at any of the substations; in fact, a great nuisance for grid operators is ensuring the homeless and vandals do not cut the fence and enter the station unauthorized. In September 2016, an unknown gunman with a high-powered rifle shot into a substation, cutting off the electricity to 13,000 customers instantly. Not only can a single attack shut off electricity to thousands of Americans, but it took six months until it was replaced—only by bringing in a portable substation in the interim was power able to be restored to customers within eight hours of the attack. The replacement time is incredibly long for high voltage transformer substations (HVTS); a coordinated attack on as few as nine critical substations could result in a coast to coast blackout from which could take years to recover. To bolster HVTS security and resiliency, we will need to have adequate spare HV transformers which can be safely secured, quickly moved when they are needed, and installed efficiently in a variety of substations to minimize costs of spares, since each spare costs $2-7.5 million or more. By increasing the surveillance onsite, it decreases response time to attack and helps identify attackers. Physical barriers around critical HVTS increases the robustness of the site and difficulty to penetrate the facility. Only letting vetted, required personnel into the HVTS will minimize those who have insider information. And finally, keeping information about critical infrastructure and HVTS confidential is vital to making coordinated physical attacks far less effective than they could potentially become. These policy actions result in a grid which is more impervious to attack, can respond in a more timely and efficient manner, and can mitigate the worst possible outcome of a multiple-year black sky hazard.

Social Sciences

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ABSTRACT

Economic Conditions and Opioid Death during Economic Expansion

This paper examines the effect of state-level economic conditions on opioid overdose death rates across the United States during the largest economic expansion. Over the past decade, the United States has been facing the serious public health crisis of the opioid epidemic. The data examined spans 2010-2017 and compares the 49 states and the District of Columbia, relying dominantly on the U.S Census American Community Survey data. Through two-way fixed effects regression models, I demonstrate that there is a significant negative correlation between unemployment rates and opioid overdose death rates, as well as a significant positive correlation between opioid prescription rates and opioid overdose death rates.

Social Sciences

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ABSTRACT

Maternal Depressive Symptoms, Intimate Partner Violence, and Child Adjustment in Diverse Families

Research has found that intimate partner violence (IPV) and maternal depressive symptoms are correlated, and are both associated with children's internalizing and externalizing behaviors. Maternal depressive symptoms are also a mediator between IPV and child externalizing and internalizing behaviors. These associations are largely understudied among low- income, non-cohabiting or romantically uninvolved co-parents.

 (1) IPV would be positively associated with both child (a) internalizing and (b) externalizing behaviors, and (2) maternal depressive symptoms, and (3) maternal depressive symptoms would mediate the association between IPV and child (a) internalizing and (b) externalizing behaviors.

Participants: 76 low-income, ethnic minority mothers (79% Black, 12% Latina, 9% Other) (Mage = 33.04, SD = 8.41; 21-60 years), with a young child (Mage = 6.28, SD = 2.99; 2-12 years, 53% boys). 38% in a romantic relationship with the co-parent, 34% cohabiting.

IPV was measured with the Revised Conflicts Tactics Scale, Maternal depressive symptoms were measured with the Center for Epidemiologic Studies Depression Scale. Child internalizing and externalizing were measured with the Strength and Difficulties Questionnaire.

H1 and H2: As hypothesized, regression analyses indicated IPV was significantly associated with child internalizing (b = .32, p = .03), child externalizing (b = .60, p <.001) behaviors, and maternal depressive symptoms (b = .60, p <.001).

H3: (a) Mediation analysis indicated that maternal depressive symptoms fully mediated the effects of IPV on internalizing behaviors. (b) Maternal depressive symptoms also partially mediated the effects of IPV on externalizing behaviors.

Social Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Maya Cook

ABSTRACT

Attachment Style in Relation To Career

Attachment styles have been known to have an impact on individuals, as seen through Bowlby's attachment theory, however, attachment styles role in predicting career choices has not been researched. This research aims to determine whether or not attachment styles, as defined through Collins' Revised Attachment Scale, relate to chosen careers. This research is imperative as it will allow psychologists to better understand what careers would better suit different types of people. 90 participants were given a survey containing the attachment scale as well as a question about their chosen career/career field. The Revised Attachment Scale sorted individuals into attachment modes: closeness, dependability, and anxiety. An ANOVA was run, showing significant findings for anxiety as related to career choice; there were no significant findings for closeness or dependability. This could be due to people with higher anxiety attachment modes not feeling comfortable branching out of their comfort zones, securing themselves into certain careers that they are most capable of doing.

Social Sciences

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Daina Eglitis

ABSTRACT

The Impact of Nazi Art Theft on the Jewish Community

This paper will use a sociological lens to analyze the effects on the Jewish community of the Third Reich systematically looting Jewish art between 1933 and 1945. This sociological lens is specifically related to the social construction of cultural objects, and the ways in which those cultural objects are utilized by different groups of people to further divisions of power in a society.

The paper will apply the classical sociological theories of Herbert Blumer and Pierre Bourdieu to the case study of Nazi art theft to argue that through symbolic interactionism, the value of a work of art subjectively comes about in a society through collective judgment. Thus, the acquisition of cultural capital through stealing such art can transform into symbolic capital–influence and authority in society–based on the socially-determined economic and cultural value of such art. The paper will delve into the purposes behind Nazi plundering of Jewish art, as well as the effects of this large-scale transfer of cultural capital on the Jewish community. The paper will incorporate primary source documentation from the National Archives and the United States Holocaust Memorial Museum Library related to the plundering of Jewish art, as well as images of art pieces that have been recovered.

Social Sciences

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ABSTRACT

The Effects of Philadelphia's 10-Year Tax Abatement

The City of Philadelphia's generous tax abatement policy exempts the value of new construction and improvements from 10 years of property taxes. We use the framework developed by DiPasquale and Wheaton (1992) to model the theoretical effects of the policy on construction, prices, rents, housing stock, and property tax revenues. We find that implementing the policy should lead to a large short-term spike in construction, but the long-term increase is only 0-5%. We also look for empirical evidence of these effects when the policy was enacted in 2000. Neither descriptive statistics nor counterfactual analysis using synthetic controls shows any evidence that the abatement policy was critical to development growth in Philadelphia. This may be partially due to buyers failing to fully value abatements when purchasing a home. We roughly estimate that the premium buyers pay is only about half of the present value of the tax benefits. Finally, we find evidence that payment shocks resulting from expiring abatements are causing mortgage delinquencies. This unintended consequence may be at least partially offset through fewer delinquencies for loans on homes with active abatements.

Social Sciences

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ABSTRACT

Understanding the Psychological Effects of Online Exclusion on Conservative and Liberal College Students

Recently, lay media have reported on damaged interpersonal relationships due to an increasingly tense political climate. Given these political tensions, individuals may be socially excluding, or feeling socially excluded from people with different political ideologies. Social exclusion occurs when an individual is excluded or ignored from a social situation, and threatens four fundamental human needs: need to belong, meaningful existence, self-esteem, and self-control. The present study examined whether liberal or conservative college students reported exclusion experiences based on political ideology, as well as if students reported that belongingness, meaningful existence, control, and self-esteem were threatened following interactions with political opponents.

A cross-sectional online survey was distributed in 2019 to college students who identified as liberal or conservative (N = 277) at a university in the Washington, D.C. area (56.8% liberals and 37.8% conservatives). Participants were asked about their political identity and frequency of exclusion experiences based on political ideology, and their reported reactions following exclusion from those with different political ideologies.

ANCOVAs controlling for gender and race examined liberals and conservatives degree of exclusion found that conservatives reported more exclusion experiences by friends (p = .002) and other students (p < .00) but not family (p = .708). Furthermore, conservatives and liberals reported similar levels of political identity strength (p = .569).

In terms of psychological needs, conservatives reported lower meaningful existence (liberals: M = 3.398, conservatives: M = 3.116, p =.012), belongingness (liberals: M = 3.027, conservatives: M = 2.786, p = .007), and self-esteem (liberals: M = 3.324, conservatives: M = 3.106, p = .023). Feelings of control did not differ among liberal and conservative students (p = .576). However, although they reported more exclusion, conservatives reported feeling significantly warmer toward the political outgroup (M = 44.918) than liberals (M = 28.214; p < .01). Overall, the current study revealed that college students do report experiencing exclusion based on their political beliefs.

Considering the finding that exclusion experiences are related to in- and out-group warmth, it may be important to consider how experiences of exclusion may contribute to political tensions. Future research should also expand upon the psychological effects of current political polarization and methods of diffusing outgroup exclusion based on political ideology.

Social Sciences

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ABSTRACT

E-Cigarette Use in College Students: The Role of Prototypes, Norms, & Perceived Vulnerability

Electronic cigarettes (e-cigarettes) are battery-powered inhalation-activated devices used for nicotine ingestion in a process commonly termed "vaping". Past month e-cigarette use doubled among college students from 6.1% in 2017 to 15.5% in 2018, prompting attention from health researchers due to incidences of lung injuries associated with e-cigarette use and connections to later tobacco use.The prototype/willingness model (PWM) is a modified dual-processing model of health behavior commonly applied to young adult risk behavior. In the model, willingness (i.e., openness to risk opportunity) is the proximal antecedent to behavior, and is determined by prototypes (e.g., social images of typical e-cigarette users), descriptive norms (perceptions of others' e-cigarette use), and perceived vulnerability (PV; perceived risk of e-cigarette use). Previous studies have shown the efficacy of the PWM in predicting risky behaviors such as smoking, alcohol use, and marijuana use in young adults. The current study explored how prototypes, norms, and PV of e-cigarette use differentially predict willingness to use by user-status within a cross-sectional sample of D.C. college students (N = 298). Prototype was computed as a product of favorability (the extent to which five descriptors were attributed to the typical e-cigarette smoker) and similarity. Descriptive norms were measured as percentage of friend use (0% - 100%). PV was computed as a product of the extent to which participants agreed or disagreed that e-cigarette use leads to dangerous health effects, addiction, or cancer. User-status was established by three categories: never-users (n = 143), non-current users (has used but not in the past 30 days; n = 65), and current users (has used in the past 30 days; n = 89). ANCOVAs controlling for gender revealed that perceptions of e-cigarette prototypes, PV, and norms varied by user-status. Never users reported worse prototypes and lower norms, PV, and willingness relative to current and non-current users. Bivariate correlations revealed that for current users, prototypes were related to use frequency (r = .348, p < .01) and willingness (r = .302, p < .01). For current users, norms were only related to use frequency (r = .303, p < .01). Results suggest targeting PWM variables may be productive for future research on vaping prevention.

Social Sciences

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ABSTRACT

Rethinking Reproductive Rights Policy and Asian American History

In recent years, there has been a growing trend of feticide laws and sex-selective abortion bans across the United States. These laws have successfully exerted their legal authority as evidenced by the conviction and imprisonment of Bei Bei Shuai and Purvi Patel. In 2011, Bei Bei Shuai, a Chinese immigrant, attempted suicide which resulted in the loss of her fetus. Under Indiana law, she was charged with attempted feticide and murder and imprisoned for more than a year. In 2013, Purvi Patel suffered a miscarriage that also resulted in the loss of her pregnancy. Similarly, she was charged with feticide under Indiana law and sentenced to 20 years in prison.

This legal punishment of pregnant women for mental, physical, and emotional complications that may accompany pregnancy is a form of reproductive violence because they attempt to control women, specifically, Asian American women. Sharan Griffin, a member of INCITE! Women of Color Against Violence, defines reproductive violence, a specific form of state violence, as "the ways in which interlocking policies, institutions, and systems of oppression operate to control and dominate Black women's bodies, reproduction, sexuality and motherhood". This definition may be expanded to include Asian American women and applied to an analysis of sex-selective abortion bans that frame these women as threats to female fetuses. As a result, reproductive violence as a form of state violence aptly defines this alarming development in the criminalization and punishment of pregnant women.

Previous analyses by scholars like Seema Mohapatra in 2015 and Jennifer Denbow in 2016 only focused on how these bans restrict women's access to abortion. However, my research complicates this policy focus by uncovering how these bans also reproduce anti-Asian immigration attitudes, insofar as they rely on racist and sexist assumptions about Asian cultures. My methodology reflects on the history of US immigration laws and analyzes current legislative arguments. I will demonstrate how the legal and policy discourse about these bans reiterate anti-Asian immigration stereotypes and constructs Asian American women as threats to female fetuses. This research project will create a new understanding about public policy and sex-selective abortion laws as they impact women's rights in the United States. More broadly, it will demonstrate why we must pay attention to the issue of race in the process of creating and enforcing legislation on reproductive rights and abortion.

Social Sciences

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ABSTRACT

Attitudes about Pets in Therapy and Culture

Several studies have examined the benefits of the therapist bringing a pet to psychotherapy sessions, yet few of these studies have addressed the patient factors that may influence that positive relationship. One of the patient factors that is likely to influence the usefulness of pets in treatment is the patients' attachment style. More insecure patients are less inclined to trust people and are more inclined to have more positive attachments to animals given the relational trauma they have experienced. Another patient factor is the patient's culture. It has been observed that animals and pets are not always perceived the same way, and attitudes towards pets are often influenced by religion, gender, and economic status. In the current study, we have surveyed 150 people using an online questionnaire and measured their attitudes toward pets, attachment style, and culture. The research is currently being analyzed using analysis of variance to determine differences between people who prefer pets in therapy and those who do not. Implications of the findings for future research and clinical practice will be reviewed.

Social Sciences

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ABSTRACT

Misinterpretation of Sexual Intent and Willingness to Engage in Sexual Coercion: Data over three decades from a Mid-Atlantic University

Sexual assault is a problem prevalent on many college campuses, including The George Washington University. This study examined sex differences in the reporting of willingness to engage in sexual coercion and the misinterpretation of sexual intent using data collected from 1,400 undergraduate students that attended The George Washington University from 1988 to 2019. We expected that males would be more likely than females to report willingness to engage in sexual coercion if they thought they would not get caught, and that this willingness would decrease over the three decades (hypothesis one). In addition, we thought that females would be more likely to report that their sexual intention was misinterpreted over the entire time period (hypothesis two). The percent of the sample indicating they might force a sexual encounter if they knew they would not get caught was low (male = x %, female = y %), and it decreased over time for both sexes (for example, decrease of 14% for males and 7% for females from 1996-2002 to 2016-2019). Regarding the second hypothesis, contrary to previous research, men were more likely than women to report that they had an experience in which their level of sexual interest was misunderstood. Over the 30 year period, the rates of misunderstanding decreased (36% for women and 8% for men). These results are examined in the context of social changes emphasizing sexual consent and new understandings of appropriate sexual interactions and scripts.

Social Sciences

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ABSTRACT

Applying The Prototype Willingness Model to Examine E-Cigarette and Cigarette Use Attitudes among College Student Users, Dual-Users, and Non-Users

E-cigarettes have grown in popularity since their introduction into the U.S market, with recent studies indicating that 26% of college students are current users. One concern with the rising popularity of e-cigarettes is that it is a gateway to smoking cigarettes. Thus, there is a need to identify ways to reduce e-cigarette use in this population. One model that predicts substance use behaviors in young adults is the Prototype Willingness Model (PWM). The PWM posits a social reaction (willingness) and reasoned (intentions) pathway to health behavior mediated through subjective norms (perceptions of how many people use e-cigarettes), prototypes (images of e-cigarette users), and perceived vulnerability (PV) to the harmful effects of e-cigarette use. The current study sought to examine if individuals who only use e-cigarettes, use both tobacco and cigarettes, or those who have never used either have different levels of PWM cognitions about cigarettes and e-cigarettes.

A cross-sectional sample of college students (age M = 19.47, 65.8% Female, 60.2% White) were recruited from a university in Texas (N = 276) and in D.C. (N = 289) to complete an online survey for course credit. Participants who indicated they co-used e-cigarettes and tobacco in the past 6 months (N = 60), used only e-cigarettes in the past 6 months (N = 129), or used neither in the past 6 months (N = 355) were included in our analyses. Analyses of CoVariances (ANCOVAs) controlling for age, location, gender, and amount of use in the past 6 months examined differences between groups.

Co-users had more positive e-cigarette prototype perceptions than non-users (p < .05), but e-cigarette users had similar prototypes perceptions to both co-users and non-users. E-cigarette and co-users had similar levels of PV to e-cigarettes, but significantly lower PV than non-users (p = .002). When looking at participants' comparative PV of tobacco and e-cigarettes, e-cigarette users and non-users reported higher levels than co-users (p = .007), but e-cigarette users had similar levels as non-users. In terms of norms, co-users reported higher perceptions of friends who smoke than e-cigarette users and non-users (p = .001). Lastly, e-cigarette willingness among co-users was higher than willingness among e-cigarette users and non-users (p < .01). These results show differences in cognitions between co-users, e-cig users, and non-users with the riskiest cognitions being with co-users followed by e-cig users.

Social Sciences

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ABSTRACT

Examining College Students' Motives to Use E-Cigarettes: Results from an Exploratory Factor Analysis

Young adults currently have the highest reported rates of vaping nicotine – in 2018, 34.7% of young adults 19-20 reported having ever vaped nicotine and 26% reported vaping in the past 30 days. Rates of e-cigarette use in this population is concerning because there is evidence that e-cigarette use can lead to tobacco use, the long-term health effects of vaping are unknown, and there are recent concerning lung-injury hospitalizations and deaths associated with e-cigarettes. In order to understand what factors relate to e-cigarette use, we can examine factors that relate to other substances highly used in this population, such as alcohol. Prior research has examined how young adults' drinking motives predict drinking behavior. However, no research thus far has explored e-cigarette use motives. In particular, the motives of current college students' with no previous e-cigarette experience should be examined in order to determine what may motivate current non-users to initiate use. The present study seeks to explore what motives non-vaping college students' report to use or not use e-cigarettes, and determine whether those motives correlate with substance use cognitions.

A cross-sectional sample of college students were recruited from one university in Texas (N = 317) and one in D.C. (N = 295) to complete an online survey for course credit. The present study focused on students who reported never having used e-cigarettes (N = 250; age M = 19.45, 66.4% Female, 52.4% White). Exploratory factor analyses (EFA) with varimax rotation determined the structures of the two motives scales: motives to use and motives to not use e-cigarettes.

Motives to use e-cigarettes loaded onto a three-factor model, and explained 70.15% of the variance in motives to use e-cigarettes: alternatives to tobacco/enhancement motives, social/conformity motives, and coping motives. The motives to not use e-cigarettes also loaded onto a three-factor model and explained 68.786% of the variance in motives to not use: outcomes and health concerns, lack of incentive, and perceived approval of e-cigarette use. Bivariate correlations illustrated that all motives to use subscales were positively related to both intentions and willingness to use e-cigarettes (p's < .05), however motives to not use e-cigarettes were not significantly related to intentions or willingness to use e-cigarettes.

Our findings suggest three-factor models of motives to use, and to not use e-cigarettes in non-users. These scales provide a tool for researchers to target certain motives in future interventions to reduce e-cigarette use and initiation.

Social Sciences

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ABSTRACT

Identifying Demographic Clusters in the 2012 and 2016 Presidential Election

In this project, we identify patterns and clusters that connect people of certain demographics to the political candidates that they vote for. We will reveal the factors that lead voters to lean to the left or the right of the political spectrum. The project is conducted based on datasets provided by Kaggle. The datasets report the results of the election for each county and state in both 2012 and 2016. It also provides information on the voters themselves (eg. population, gender, race, education level) within each county and state.

This study pertains to the examination of factors such as race, education status, population, and geographical location. When we identify certain clusters and patterns, we will attempt to uncover the components linking politicians with certain demographics. we will identify states that share commonalities in terms of those demographic variables. To avoid getting overwhelmed by an influx of information, we start small. Our datasets are the core of our analysis. Factors not touched upon in the data (e.g. politicians' reputations, vision) are not prioritized in our study. We limit the places being assessed to 50 states (each state represented by a node) and limit the variables used to evaluate those states.

We examine the country's voters in 2012 and 2016 in more detail and determine which states preferences shifted from democrat candidates and republican candidates from those two elections. States with a similar type of shift will be connected to each other through links on the network. Then, the commonalities between states with similar shifts and discrepancies between states with different shifts will be evaluated.

The main tool used for this project will be R. Libraries such as igraph will be central to our analysis. This project mainly targets PR teams in politics (or any business field). Primarily, plotting and studying these networks will give insight into how the public voters behave based on their personal circumstances and based on the politicians in question. A takeaway of this project would be to identify the priorities that a pr team (of any business/organization) should consider when attempting to win over the public.

Social Sciences

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ABSTRACT

Comparing Undergraduate and Primary Care Patients on PA Goals and Type of Motivation

The potential benefits of delivering interventions aimed at increasing physical activity (PA) in the primary care setting are gaining recognition. One theoretical framework used to develop PA interventions is Self-Determination Theory (SDT). Convenience samples (i.e., undergraduate students) have been widely used to support central tenants of SDT. To further the development of SDT-based interventions targeting PA among primary care patients, we first need to know how these two samples compare. Therefore, one objective of the present study was to compare exercise goals of undergraduate students with those of primary care patients. A second objective was to compare internal and external motivation for PA between these populations. PA goals and type of motivation are constructs central to SDT, thus comparing undergraduates to patients on these factors will help determine whether preliminary PA interventions developed with student samples can inform the design of similar interventions targeting primary care populations.

Patients were recruited from a primary care clinic affiliated with a university. Only those who reported having engaged in a PA routine for at least two weeks within the past year were included in analyses (N=383; Male = 40.2%; African American = 43.6%; Mage=49.4, SD=16.41). Undergraduate students were recruited from the psychology department subject pool (N=265; Male =49.1%; White = 62.3%; Mage=19.4, SD=1.36). Procedures included completing a self-report questionnaire. Patients completed a one-page questionnaire at check-in. The questionnaire completed by undergraduates was part of a larger study investigating PA and health behaviors. Items completed by the two samples were identical. Measures that were assessed included exercise goals, average weekly vigorous, moderate, and light PA, and exercise regulation. Data from both samples were merged for analysis.

The goals most frequently endorsed included, tone/body shape (45.2%), stress reduction (42%), overall health benefits (40.6%), weight maintenance (35.8%), weight loss (28.7%), and sense of well-being (24.2%). These goals were generally endorsed with similar frequency across the samples. Exceptions were for weight maintenance, tone/body shape, and overall health benefits, where students endorsed these with greater frequency than the patient sample (all (χ2 >8.1, ps<.01). Patients reported greater levels of internal regulation (M=5.20, SD=1.26) than students (M=4.56, SD=1.19; t=-6.41, p<.01). Patients also reported lower levels of external regulation (M=0.87, SD=1.16) than students (M=1.64, SD=1.23; t=7.99, p<.01). In sum, primary care patients and students reported similar PA goals. There were some differences in the amount of internal and external motivation. Implications of these differences for developing interventions will be discussed.

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ABSTRACT

Eco-Feedback, Pro Environmental Behaviors, and Energy Consumption

Previous work has explored the influence of energy monitoring systems (EMS); however, further understanding of implementation strategies is imperative. Privacy concerns depend on anticipated consequences of EMS, such that negative consequences correlate with increased concern for privacy and vice versa.

It is expected that as communicated purpose transitions from financial benefit for the organization to CO_2 reduction, pro-environmental behavioral intention will increase (H1); as pro-environmental behavioral intentions (H2), pro-environmental self-efficacy (H3), and sustainable values (H4) increase, concern for privacy will decrease; and, as pro-environmental behavioral intentions increases, sustainable values (H5) and pro-environmental self-efficacy (H6) will increase.

131 participants, recruited via snowball sampling (within a social media platform), completed an online study of the relationship that both apportionment of data (individual vs. group) and communicated purpose of energy-use-monitoring (financial benefit vs. CO_2 emission reduction) have on employees' concern for privacy, pro-environmental behavioral intentions, self-efficacy and sustainable values.

Consistent with H1, as communicated purpose changed from lowering emissions ($\bar{x}$ = 5.979) to cost reduction ($\bar{x}$ = 5.468), pro-environmental behavioral intentions decreased ($F_{1,107}$ = 4.580, $p < 0.035$, n = 111); consistent with H2, H3, and H4, as pro-environmental behavioral intentions, self-efficacy, and sustainable values increased, concern for privacy actually decreased (r = -.445, $p < .0001$, n = 131; r = -.286, $p < .001$, n = 128; r = .202 (reverse scored), $p < .030$, n = 115, respectively). Consistent with H5 and H6, as pro-environmental self-efficacy and sustainable values increased, pro-environmental behavioral intentions increased as well (r = .332, $p < .0001$, n = 128; r = .326, $p < .001$, n = 15). Finally, and of note, as monitoring changed from individual ($\bar{x}$ = 3.074) to group ($\bar{x}$ = 2.728), self-reported energy use decreased ($F_{1,99}$ = 7.185, $p < .009$ n = 103).

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ABSTRACT

The Negative Effect of Minority Status on Major-Party Campaign Spending

This paper investigates the impact of women's racial minority status on campaign spending by the two major U.S. political parties. It uses a linear regression and a sample of female candidates for congressional House offices from 2002 through 2008. This paper finds that a woman's race has a significant negative impact on the amount of spending on her campaign. The paper focuses narrowly on female candidates from a particular time frame because there is little data available on the minority status of congressional candidates. More research is needed to determine the full scope of the impact that all minority statuses (gender, race, and LGBT+ status) have on major party campaign spending, especially since this kind of relationship has not been studied before.

Social Sciences

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ABSTRACT

Ethnic Differences in Length of Stay among Psychiatric Inpatients in the United Kingdom

Disproportionate rates of psychiatric admissions and length of stay (LOS) have been repeatedly observed among Black and Minority Ethnic (BME) groups with severe mental illness (SMI), specifically those of Black Caribbean heritage. Commensurate understanding of the mechanisms underlying this observation remains poorly understood, warranting further attention. A quasi-experimental retrospective cohort design was used to examine 11,617 psychiatric inpatient admissions in London, U.K. Variations in LOS across four ethnic groups (i.e., Black Caribbean, Black African, White British, and Asian) were recorded. Multivariate logistic regression was then used to determine the extent to which demographic (age, marital status, gender, homeless at admission), clinical (primary diagnosis, substance misuse), and assault variables (violent behavior, deliberate self-harm, victimization) explained any observed differences across ethnic groups. Whilst univariate results confirmed significant disparities in LOS across all four ethnic groups, after multivariate adjustments, statistically significant variations were no longer observed among BME groups (i.e., Black Caribbean, Black African, and Asian). Notably, statistically significant differences remained between BME and the majority (i.e., White British) ethnic group, with the former consistently demonstrating longer (>29 days) LOS. The final model explained approximately 18% of the observed variance in LOS. These findings indicate that additional variables must be examined to better understand the relationship between BME groups and LOS and in order to improve the experience and outcomes of these populations.

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ABSTRACT

Impact of Being a Tri-State Area on Youth Tobacco Use under Minimum Legal Sales Age (MLSA) Legislation

The purpose of the recent federal minimum legal sales age (MLSA) legislation in December 2019 was to raise the age to buy tobacco products from 18 to 21 years old nationally. Prior to this law, 19 states as well as Washington, D.C. had already used their state power to raise their tobacco age to 21. However, the effectiveness of this policy was questioned in regions that bordered other states who did not yet adopt Tobacco 21 laws. One such example is Washington, D.C., where youth claimed that the MLSA law in 2017 was ineffectual due to the region's proximity to Virginia and Maryland, two states who did not adopt Tobacco 21 laws until 2019. In those two years, youth – even those under 18 – claimed that they could have easily crossed the border in order to purchase tobacco products in either state, where age verification was more relaxed and there were reduced costs for retailer non-compliance.

A natural experiment is created due to the varied introductions of Tobacco 21 laws in states. Using the data from the Youth Risk Behavior Survey (YRBS) for both District of Columbia and San Diego, California (who had adopted their MLSA law in mid-2016), I compare the effect of being a tri-state area on cigarette, e-cigarette, alcohol, marijuana, and illegal drug use for high school students before and after their region's MLSA law was enacted.

Preliminary review of the data shows that adopting the Tobacco 21 law in D.C. from 2017-2019 had significant impacts on the current use of electronic vapor product and illicit drug use but no significant impacts on current cigarette use, current electronic vapor product use frequently or daily, alcohol use, or marijuana use compared to San Diego. These results suggest that an additional 5.2% of students may have taken advantage of the nearby borders to obtain e-cigarettes proceeding D.C.'s MLSA law, but they did not do so frequently or daily. Being a tri-state area also has no significant impact on youth conventional cigarette use following the MLSA law. In conclusion, the MLSA law were undermined in regard to the youth e-cigarette use in D.C. from 2017-2019 due to the region's close proximity to states who did not yet adopt Tobacco 21 laws.

Social Sciences

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ABSTRACT

Everyone Own's That! Children's Intuitions about the Proprietary Nature of Unique versus Publicly Available Ideas

By the time we've reached adulthood, we've developed an explicit understanding of the proprietary nature of concrete and abstract concepts. Adults understand ideas and objects in the public domain are available for use without consequence, while private ideas cannot be imitated, without a cost. The ease at which we consume and repeat public information begs the question, "Do preschoolers, like adults, intuitively distinguish between private ideas that when imitated, have a cost from those that are available for public consumption and can be imitated without a cost?" Or are such distinctions a late-developing skill? We explored this question by testing whether children ages 4-6 (n=96) had the ability to identify the owner of public and private ideas or objects. Recruiting at the National Building Museum, we used a storybook narrative via Google Slides to display two story conditions (toy object, animal story) within two contexts (private, public). The public context involved a character hearing an animal story on TV or playing with a toy in a toy store. The private context involved a second character telling a novel animal story or playing with a toy in their home. We hypothesized that children would treat novel animal stories and privately-owned toys as proprietary but publicly available information or objects as a public good that cannot be privately owned. Preliminary results indicate that children's ideas of ownership are consistent with our hypothesis. In comparison to chance (33%), a significant amount of children indicated that the owner of a public story, that was first heard on television, belongs to "Everyone/No one" ($p < 0.001$). No other response (1st possessor of story or a 2nd character who retells the same story) differed from chance. In the private stories, however, where children heard two stories the 1st repeating a public and 2nd saying a new story, chose the 2nd character as the owner of the new story ($p < .05$) more often than chance. These responses show that children as young as 4 understand how specific knowledge can be used freely (or owned) by everyone, while particular goods (like privately-owned objects) cannot be freely used (or owned) by everyone. The parallels in adults and children's ideas of ownership across a physical and psychological domain suggests that ownership is an early appearing, intuitive concept that is domain-neutral. This then can be used to frame the issue of what is and isn't imitable.

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ABSTRACT

Volunteer-Youth Relationships: An Evaluation of Life Pieces to Masterpieces's Volunteer Program

The DC based organization Life Pieces to Masterpieces (LPTM) operates an after-school program which focuses on the character and leadership development of African American boys and men. This program relies heavily on support from a volunteer network primarily comprised of local university students. LPTM hoped to evaluate their management of these volunteers to ensure the volunteers were creating effective relationships with the boys of the program. Specifically, this concerns the mutuality of these relationships and the impact they have not only on the apprentices, but also on the volunteers. The client sees this as a vital aspect of the volunteer role and thus requested an outside evaluation be conducted. The evaluation was conducted using semi-structured interviews with seventeen George Washington University and American University student volunteers with the program. The interviews were then coded. The most prominent trends pertained to the elements the volunteers saw as being factors of meaningful relationships, perceived contributions the volunteers believed they were having on the apprentices, what takeaways have they learned that they will take from LPTM, and how they foresee their experiences will impact their personal lives. Based on these results, there were multiple areas of improvement discovered that LPTM can use to increase volunteers' capabilities once at site. The evaluation also found that including a required reflection component into the volunteer role will ensure volunteers are able to draw comprehensive conclusions about the time they spend at LPTM, as many of them expressed the importance of their work, but they were unable to see its impact on their lives out of onsite time.

Social Sciences

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ABSTRACT

Bureaucracy in Black Holes

Much of the research on how hierarchy impacts the deadliness of terrorist organizations is outdated or fails to address the role an environment can play in this effectiveness. This study seeks to update the research to 2018 while accounting for environment by only examining terrorist organizations that are based in destabilized regions known as "black holes." The study uses Kilberg's coding methodology to classify organizations on the State Department's list of Foreign Terrorist Organizations as all-channel, hub-spoke, or bureaucracy. Lethality was calculated using data from the University of Maryland's Global Terrorism Database. An Analysis of variance (ANOVA) was used to test the relationship between hierarchy and lethality. Results showed some variance between groups for the number of injuries, deaths, and total attacks, but because of the small sample size, the significance was low.

Social Sciences

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ABSTRACT

The Effects of Student Debt on Homeownership

Rising levels of student debt have sparked public discussion on the potential impacts of student debt on homeownership. To test this empirically, I use data on college debt, homeownership, and multiple control variables from individual-level survey data from the Panel Study of Income Dynamics across four years in 2011, 2013, 2015, and 2017. The analysis utilizes linear probability, probit, and logit models to study the relationship between a change in an individual's level of student debt and the likelihood they become a homeowner. I hypothesize that higher levels of student debt will have a statistically significant impact on the probability of homeownership, controlling for variables such as age, race, region, parents' income, and years since completion of a bachelor's degree. These results have important implications on research surrounding the negative externalities of student debt.

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ABSTRACT

Creativity in Confinement: A Multiple-Case Study on Self Determination Theory and the Open Studio Model in a Juvenile Detention Facility

The three innate psychological needs according to Ryan and Deci's (2000) Self Determination Theory (SDT)—competence, autonomy, and relatedness—all become inherently limited once an adolescent is detained within a juvenile facility. Both spoken and unspoken rules maintained within such an institution yield a culture of submission, assimilation, and isolation, thus subjugating residents to limited opportunities for attaining the needs conducive to optimal psychological well-being. The present case study explores the implications of access to an open-art studio in a facility where neither art class nor art therapy is currently offered. As part of a weeklong, facility-wide enrichment program, all residents of the detention facility were offered 45 minutes of daily open art studio with a visiting art therapist-in-training. The adolescents (N = 28) met in groups of 4-7 participants and received intentional time to look at and discuss artwork made by self-taught incarcerated artists, receive instruction for a wide variety of materials, and pursue individual projects. This case study highlights the experience of ten participating adolescents. Artwork created during open studio sessions was categorized by the following recurring themes: (1) experimentation with new materials/mastery of a familiar materials, (2) depiction of a pleasant or comforting scene, (3) expression of positive aspects of self, and (4) commemoration of a deceased loved one. These themes suggest that when provided adequate time, resources, and support, the desire for competence, autonomy, and relatedness are spontaneously expressed through art-making. Implications of this case study provide support for the open-studio framework in enhancing psychological well-being.

Social Sciences

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ABSTRACT

National Service: Exploring the Origins and Evolution of a National Movement.

In his seminal work, Democracy in America, Alexis de Tocqueville (1838) noted that when Americans have an idea they "want to produce in the world, they seek each other out; and when they have found each other, they unite." Tocqueville's observations identified a unique civic culture rooted in an ethos of volunteerism and civic engagement. Throughout the country's history, leaders including politicians, educators, philanthropists, and non-profit founders independently fostered civic culture in their local communities but also on a larger, national scale. This began with William James' "Moral Equivalent of War" progressing through Franklin Delano Roosevelt's Civilian Conservation Corps, and John F. Kennedy's Peace Corps. At the end of the 20th century, service leaders drew inspiration from such programs to build a movement, which resulted in the Corporation for National and Community Service (CNCS). This formal establishment was a pivotal moment in American history. Yet, never before has any effort been made to preserve the stories of these leaders. Hence, the purpose of this study is to gather oral histories from significant leaders of the national service movement to understand the origin of national service as it is recognized today by the programs of the CNCS. The methodology of oral histories allows participants to share their unique experiences building national service. To date, 12 leaders have provided oral histories. After transcribing the oral histories verbatim, the researchers employed the constant comparative method of data analysis to identify emergent themes. One of the most significant findings is that due to external constraints such as inadequate federal funding, has limited national service's growth and it's potential remains unrealized. The findings from this study offer implications for future policies, organizational development theories, public private partnership, and civic and social well-being of our communities. This study's findings will be shared with the National Archives on National Service to inform, educate, and inspire the general public and current national leaders of the significance of national service.

Social Sciences

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ABSTRACT

The Effects of Student Debt on Homeownership

Rising levels of student debt have sparked public discussion on the potential impacts of student debt on homeownership. To test this empirically, I use data on college debt, homeownership, and multiple control variables from individual-level survey data from the Panel Study of Income Dynamics across four years in 2011, 2013, 2015, and 2017. The analysis utilizes linear probability, probit, and logit models to study the relationship between a change in an individual's level of student debt and the likelihood they become a homeowner. I hypothesize that higher levels of student debt will have a statistically significant impact on the probability of homeownership, controlling for variables such as age, race, region, parents' income, and years since completion of a bachelor's degree. These results have important implications on research surrounding the negative externalities of student debt.

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Amy Whitesel

ABSTRACT

Mental Health Documentation in Pediatric Medical Records

The Early Growth and Development Study (EGDS), a prospective parent-offspring adoption study, has compiled hundreds of medical records for over a decade, in order to obtain medical information on children's physical and mental health. The medical records are provided by pediatricians in varying formats and levels of information, with the primary focus on physical health. However, it is not clear how medical professionals address other domains of child health such as emotional health. More specifically, there is limited information on the development of behavioral and psychological issues within child medical records, creating a gap in information that otherwise could assist pediatricians in caring for their patients, primarily children in the current study. Pediatricians have the advantage of consistently examining children, which provides the opportunity for the physician to ask brief questions about children's mental health and behavioral development over time. Regular mental health assessments can create a consistent record of the child's emotional and behavioral health, allowing pediatricians to recognize and target any emotional and behavioral problems that may arise early on in the child's development and identify children at increased risk for developing mental health problems. These findings have valuable implications for improving the overall evaluation, treatment, and continuity of care for children at risk for mental health issues, thereby lessening the severity of psychological symptoms in the future. This project will present data on the review of 50 child medical records to determine the number of records that assesses behavioral and/or emotional health. The presentation will include suggestions for the medical community in assessing all domains of a child's health.

Social Sciences

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Neil Johnson

ABSTRACT

When a City Sneezes, Does The Rest Of The World Catch A Cold?

In the current Covid-19 virus outbreak, as well as previous ones such as MERS-CoV (2012-2016), the transmission effectively forms networks between individuals as well as between communities, because of the way the virus crosses from infected individual(s) to susceptible ones. Our research aims to identify the most crucial infected nodes, but with the focus on geographical regions rather than individuals as the unit of analysis. Our goal is to examine if there is a notion of spread between countries, and hence if one country can be regarded as "infecting" another. This is a novel twist on typical epidemiological models, which focus instead on individual cases.

Our analysis is based on the current 2020 Covid-19 epidemic and the dataset was acquired from Johns Hopkins Hospital GitHub Repository. https://github.com/CSSEGISandData/COVID-19. This dataset relies upon multiple sources including data from World Health Organization (WHO), China CDC (CCDC), Hong Kong Department of Health, US CDC, Government of Canada, European Centre for Disease Prevention and Control (ECDC), Ministry of Health Singapore and many more. The data focuses on the number of confirmed cases, recovered cases as well as death in a geographical location over time. Specifically, we created a novel network graph to monitor the spread of the Covid-19 within global regions, from its inception until the present day. In addition, we studied the rate of spread of the disease and the betweenness centrality of the place of origin of the virus over time.

Our analysis used the R programming language mainly, with the libraries iGraph and forecast among others. We used D3.js for plotting the network graphs. After gathering the data, we compared confirmed cases to deaths, as well as deaths to recovered cases. We then applied several network centrality metrics such as the degree, betweenness and closeness, to quantify the connectivity among Covid-19 cases. In general, the nodes (regions) with the highest degree have the most ties to other regions in the network. In addition to being of general interest globally, our analysis would be particularly beneficial to the transportation industry since the virus appears to be mostly spreading between countries via the airline networks. Since airlines are the fastest mode of travel, it is the pattern of airline routes between countries that relates to the pattern of spread of virus between countries. Hence our analysis can aid the airline industry in deciding which airline routes to suspend or re-open. Additionally, Global Health Organizations can utilize our findings to channel relief to affected areas.

Social Sciences

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ABSTRACT

The Relationship Between Physical Activity & Postpartum Depressive Symptoms

Postpartum depression (PPD) is a pervasive public health issue. Approximately 22% of women experience depression in the first year after childbirth. The relationship between symptoms of PPD and exercise in the early postpartum period remains poorly understood despite the well-established finding that physical activity decreases risk of psychological distress among adults in the general population. Physical Activity (PA) in the postpartum period is typically either measured objectively (accelerometer) or subjectively (self report), but few studies look at objective and subjective measures together. The current study examines the relationship between self-reported depressive symptoms and subjective and objective measures of PA at 6 weeks postpartum. Women reporting more physical activity are hypothesized to have fewer PPD symptoms.

The sample included 50 healthy participants recruited from an obstetrics setting. Eligibility criteria included: (a) first-time mothers; (b) between 28-32 weeks gestation; (c), no history of restless leg syndrome or diagnosed sleep disorders; (d) no previous history of psychiatric disorders. The sample was 63% white with 82% of women reporting their perceived socioeconomic status to be a 6 on a scale from 1-10 (1=least affluent, 10=most affluent). At 6-weeks postpartum, women completed a PPD measure (Edinburgh Postnatal Depression Scale), a modified subjective physical activity measure (Epic Physical Activity Questionnaire 2), and wore a wrist-based accelerometer that measured objective levels of physical activity over an average of 10 days. Ten women completed subjective measures, whereas 29 women had usable data from accelerometer assessment. Bivariate correlations were conducted between depressive symptom severity and: (a) objective physical activity, and (b) subjective physical activity.

Greater objectively-measured physical activity levels were significantly associated with lower depression symptoms, at 6-weeks postpartum (n= 29, r= -.34; p= .04). Similarly, subjective physical activity was significantly associated with lower depression symptoms (n= 10, r= -.58 and p= .04).

As hypothesized, mothers who engaged in more physical activity (measured both objectively and subjectively) had fewer depressive symptoms. The correlations between both assessments of physical activity, and their relationship to depression symptoms are moderate, suggesting that both forms of measurement showed similar relationships with symptom severity. The sample size of this study was small, limiting result generalizability. Further work on this relationship with a larger sample size can inform clinical recommendations for optimal postpartum PA.

Social Sciences

Columbian College of Arts and Sciences

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ABSTRACT

Bilateral Art Therapy: Supporting Women Transitioning From Incarceration

Though art therapy research has been conducted in association with various populations, there is limited research on the use of a trauma-informed art therapy protocol with currently or previously incarcerated women. In order to address this research gap, the researcher conducted a qualitative case study utilizing McNamee's bilateral art therapy protocol to explore the process and lived experience of a previously incarcerated woman enrolled in a transitional housing facility and participating in individual therapy sessions. This study occurred over the course of six sessions: one introductory session, four sessions utilizing the bilateral art therapy protocol, and one debriefing session. At the culmination of this study, data were collected and analyzed using thematic analysis. By collecting qualitative data, this study yielded a description of the process and lived experience of the participant as well as offered insight into how and why the bilateral art therapy protocol may support this population through reshaping negative cognitions about self into more positive cognitions about self, raising self-esteem, and increasing motivation to envision and work toward a life outside incarceration. The findings of this study suggest that this bilateral art therapy protocol has merit as a tool for supporting women transitioning out of incarceration as well as pointing to the need for further research of bilateral and trauma-informed art therapy protocols with this population.

Social Sciences

Columbian College of Arts and Sciences

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ABSTRACT

Family Support as a Moderator of Associations between Religiosity and African American Youth Self Esteem

Prior research has consistently linked African American adolescents' religiosity with their psychological well-being, including positive self-esteem. Thus, adolescent religiosity represents a promising target for interventions aiming to protect and bolster African American adolescents' well-being. Of relevance, adolescence is a period marked by growing independence, including increased religious autonomy. As adolescents may begin to cultivate and/or deepen a religious identity separate from their parents', the extent to which parental influences play a continued role in determining positive outcomes associated with adolescents' religiosity is of interest. One study linking adolescents' religiosity and psychological well-being, even in the context of low parent religiosity, suggests that adolescent religiosity's promotive effects may facilitate positive adjustment over and above religious support from parents. However, it is unclear whether the positive effects of youths' religiosity on self-esteem require a context of parent/family support more broadly. Thus, the current study examined whether the association between adolescent religiosity and self-esteem varied at different levels of family emotional support.

Participants were 817 African American adolescents ages 13-17, who participated in the National Survey of American Life- Adolescent Supplement. Youth reported on their religiosity, family support, and self-esteem.

Regression analyses revealed significant main effects between emotional support and self-esteem (β= .259, p= .000). Additionally results suggest that, in the context of high family emotional support, the more religious youth are, the higher their self-esteem (β= .119, p= .030).These results indicated thatwas a necessary factor in promoting adolescent religiosity and therefore, producing high self-esteem. Some implications of these findings were that religiosity alone was not what facilitated positive self-esteem, but rather religiosity along with family support. Future studies might explore if and how gender plays a role in how parents show support and how children perceive support differently. The present study provides evidence that highlights the role of familial support, and indicates the positive effects of increasing that support among religious Black adolescents. Programs focusing on family support upon religious families could be beneficial for adolescents.

Social Sciences

Columbian College of Arts and Sciences

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Sarah Wagner

ABSTRACT

Living the Impunity: Refiguring the Aftermath of State Crime

Impunity has been an obstacle to peace processes, social stability, institution-building, and human security across the globe, but nevertheless is often conceptualized in ways that reduce it to a juridical concept or a feature of institutional corruption. In Latin America, however, "la impunidad" translates as a "culture of impunity" which facilitates not only quotidian illegality, but also political violence and grave violations of human rights. In this context, scholars have documented it as a driver of violence and a productive mechanism of power, defined by and investigated through the multiple absences it engenders—absence of accountability, of information, of loved ones, of safety, and of reparation. Impunity is an urgent matter of concern in Colombia, where (a) more citizens have been victims of enforced disappearance and extrajudicial executions (termed State crimes) in this constitutional republic than under the combined Southern Cone dictatorships, and (b) State crime continues even after the 2016 Peace Accords signed with the country's largest guerrilla army ended a 53-year armed conflict and established a visionary and internationally lauded system for guaranteeing truth, justice, reparation, and guarantees of non-recurrence to those affected by the conflict.

As this project documents, impunity exerts a palpable presence in the lives of victims of State crime in Colombia. The lack of redress coupled with ongoing insecurity and a climate of denialism make impunity a very real, lived reality as well as a threat. In their struggle against impunity, families have been producing extensive and detailed knowledge about impunity and State crime for nearly four decades. Their work refigures impunity from an abstraction to a lived condition and from an absence to a social presence. As one mother of a victim of extrajudicial execution once told me, families live the impunity that perpetrators benefit from.

This project contributes to research on transitional justice—a key element of the social world that victims of State crime in Colombia are currently navigating—by documenting the misalignment of categories of redress and the causes of violation. It also contributes to the theorization of impunity as an active social force and to studies of human rights and political violence.

Social Sciences

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ABSTRACT

Impact on Community Composition of Restoration Techniques in the Inner Mongolian Region

The goal of this project is to gain a deeper understanding of restoration efforts across Inner Mongolian region and finding best practices for this ecological zone. In this research I compare vegetation composition and soil nutrients across four experimental restoration sites in the region of Naiman Banner. The data used for this project was collected during both the summers of 2009 and of 2018. The data was collected every ten centimeters along transects of either 25 or 50 meters in length, and included metrics such as plant cover, species count, and percent cover across four treatment sites, and one control site. Data analysis on these metrics was used to understand changes in community composition across two time series. The analysis included calculating summary statistics, dissimilarity indices on the different treatments for each year, the ordinations and scores for each recorded species which were scaled using non-metric multidimensional scaling with stable solution. The results of the analysis highlighted the various overlaps in species and community composition across different treatment sites. These results provide insights into the effect the different treatments could have on community composition and diversity once restoration practices are implemented. I also analyzed the effect of changes in nitrogen and carbon levels across both time series on community composition. The second part of this project will involve a literature review of current restoration projects in the entire region, where I will compare the effectiveness of various treatments as well as indicators of successful restoration.

Social Sciences

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ABSTRACT

Cerebellar Contributions to Social Learning in Adolescents with and without Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder which, according to the Center for Disease Control, affects approximately 1 in every 59 children. ASD symptom load varies between individuals, with different manifestations of social and nonsocial difficulties. Commonly, adolescents with ASD experience a social deficit when attempting to learn about their peers. We have shown in a previous study, when learning about others, adolescents with ASD rely upon their own preferences when making inferences about their peers' likes and dislikes. Typically developing (TD) adolescents, however, will rely on information about other peers and update their initial estimates about a peer's preference based on feedback from that peer. This updating mechanism relies on the prediction error - the difference between participants' initial estimates and received feedback

The cerebellum has long been understood to support learning in motor tasks but has also more recently been shown to support cognitive processes such as working memory, language processing, spatial processing, and attention. Here we will explore the role of the cerebellum in supporting social learning in typical adolescence and investigate differences between TD and ASD group. In line with recent studies, we hypothesize that the cerebellar posterior lobe (CPL) plays an important role in encoding prediction errors to facilitate social learning in TD adolescents. In contrast, we expect adolescents with ASD to show reduced encoding of prediction errors.

Specifically, we will be investigating CPL activation differences in TD (N=26) and ASD adolescents (N=20) while learning about a peer's preferences. We will use the SPM SUIT toolbox to extract the cerebellum from the whole-brain MRI scan and FSL FEAT to relate CPL activities to prediction error magnitudes.

Social Sciences

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ABSTRACT

The Impact of Flexible Work Arrangements on Internship Positions

For years, researchers have explored the impact of flexible work arrangements on employee morale, performance, turnover, and work-life balance. Positive benefits of such policies have been correlated throughout numerous studies among different industries. However, research has not been conducted on the impact of such policies on internship positions. This study will explore the previous research around work-life challenges, the benefits of internship opportunities to college students, and the ability of flexible work arrangements to create more fluid and effective processes for college students in internship positions.

While internship experience is not required for the majority of entry-level positions, it has proven to be beneficial when seeking employment, post graduation. A report conducted by PR firm, Accenture, in 2017, recounted that 78% of college graduates had previously completed an internship. Currently, college students are faced with the decision to sacrifice additional industry experience that may set themselves apart upon entering the work force due to inability to prioritize being a student due to the lack of flexibility within such positions. It is the hope that the findings of this study will influence organizations to offer flexible work arrangements to their internship positions, allowing a greater opportunity for college students to participate and thrive in programs on top of their school year responsibilities.

To test such conditions, a survey was conducted on undergraduates at The George Washington University who have prior internship experience. It is expected that the accommodation of flexible work arrangements in an internship position will directly increase the likelihood that college students will be able to apply, secure, and complete internship programs during the school year.

Social Sciences

Columbian College of Arts and Sciences

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Hilary Silver

ABSTRACT

Do Evictions Really Cause Homelessness?: A Single County-COC Statistical Analysis

The overall issues of evictions and homelessness are becoming much more visible today, with the terms "housing crisis", and "eviction epidemic" gaining popularity in the academic and political debates. Much of the literature around evictions and homelessness in the recent years has cited or revolved around studies done by Matthew Desmond claiming that evictions are a direct, and significant cause of homelessness. However, it does not seem as though there has been much academic or statistical critique of Desmond's claims about evictions and homelessness or of his data. This critique is important because the data in Desmond's Eviction Lab is increasingly being used by law and policy makers to determine decisions regarding housing policies. Therefore I conducted a statistical analysis of data from both Eviction Lab, and the United States Department of Housing and Urban Development to determine if this relationship does truly exist. Because of limited time and resources, I was only able to use data from single county Continuums of Care for four different points in time, but that still gave me over 600 independent variable points to work with. To approach this issue, I discuss some case studies and other literature that could call Desmond's claims and data into question. I used SPSS to analyze the data I complied from HUD and Eviction Lab to calculate correlations and regressions.

As a result of the above procedure, for my selected time frames and COCs, Desmond's claims have truth behind them and his base case study from Milwaukee may have significant generalizability. While my current results prove these, it also shows that more research needs to be done on this connection between evictions and homelessness, because my current data set does contain limitations, and there are many other independent and control variables that can be added into the equation, such as number of affordable housing units, shelter bed counts, and percentage of different races among the COC population.

These present and future findings on this issue are important because homelessness is a persistent problem in American society, affecting already marginalized groups of people. The increasing visibility of today's homeless is also leading to policies and practices that are additionally detrimental to their wellbeing and can make it more difficult to successfully exit homelessness. In order to find effective solutions to homelessness, the true causes and rates of homelessness need to be understood. I am currently working on the second step of this research, which includes all Continuums of Care, and many other independent/control variables for this issue.

Social Sciences

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ABSTRACT

Sex Differences in Sexual Fantasies

According to the evolutionary perspective, sex difference has been found in human mating preference, strategies, and reproductive success. Studies inspired by modern evolutionary theory have also been conducted to examine sex differences in sexual fantasies. These two findings made one wonder whether the two sex differences based on the evolutionary theory are related. Thus, the main goal of this research was to analyze whether mating preferences could predict sexual fantasy preferences. Are mating preferences of males and females manifested in their content of sexual fantasies. If the correlation exists, men and women should have significantly different sexual fantasies in categories where differences have been found in mating strategies. The categories examined in this research included partner number/accessibility, resources and willingness to invest, and fertility/gene quality. The study hypothesized that males would fantasize more about partner number/ accessibility and would have more intra-sexual aggression, while females would fantasize more about resources and willingness to invest. Also, it was expected there would not be sex differences in fantasizing about fertility/gene quality. Participants were 1,167 students at George Washington University who took Psychology of Sex Difference course between 1986 and 2019. The participants completed a large survey that included demographics as well as surveys about personality, sexual behavior and attitudes including sexual fantasies. The participants were asked whether they had ever experienced twenty different sexual fantasies. The participant data were combined into four year eras (e.g., 1986-1990, etc) and data were analyzed by era rather than by year. The results indicated that males fantasied more about partner number and partner accessibility than did females, and this was true for all eras. However, the other hypotheses of resources/willingness to invest, fertility/gene quality, and intra-sexual aggression were not supported: there were no sex differences in these types of fantasies. In addition, males reported more fantasies than females, and the amount of sex fantasies did not change over time. The results show partial support for the connection of mating strategies with sexual fantasies, notably for males.

Social Sciences

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RESEARCH MENTOR/DEPARTMENT CHAIR

Christina Gee

ABSTRACT

Examining the Role of Social Support and Strain on Loneliness and Satisfaction with Life among College Students

Research has shown that perceived social support has a positive impact on physical and mental health. What is lesser known, however, is the role that relationship strain has on psychosocial outcomes and if support impacts this relationship. The current study investigated the association between strain and psychosocial wellbeing (satisfaction with life (SWL) and loneliness), and the potential moderating role of social support. We hypothesized that higher perceived social support would be associated with higher SWL and lower levels of loneliness, and that higher levels of strain with mothers, friends, and romantic partners would be associated with lower SWL and higher levels of loneliness. Additionally, we predicted that higher levels of perceived social support would moderate this relationship in that social support will weaken the effects of strain on the outcome variables. In the school year of 2018-2019 data were collected through an online survey administered at two time points, approximately a month apart, to GW undergraduates ages 18-24 (N=179). The sample was primarily female and was fairly diverse, with just over 55% of the sample identifying as white. The survey assessed overall levels of perceived social support, strain from individuals in respondent's social support network, and ratings of life satisfaction and loneliness. Bivariate associations indicated that strain from romantic partners was associated with higher levels of reported loneliness at time 2 (T2) (p= 0.003). Additionally, strain from mothers was associated with lower levels of SWL at T2 (p=0.004). These findings highlight the important role of strain in relationships and the limitations of social support, especially among college undergraduates. They also can be used to inform intervention strategies to help college students better understand the important role that relationships have on overall wellbeing.

Social Sciences

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Kathleen Roche

ABSTRACT

Language Brokering: The Moderating Effects of Parental Support and Gender on Adjustment in an Adolescent Latino/a Sample

Latino youth of immigrant families are one of the fastest growing ethnic groups in the US population. For youth in families in a new immigrant destination, language and cultural brokering, the translation and interpretation of information by youth for their parents, is necessary given the lack of support available to immigrant families in the US. However, language brokering can have negative effects on youth's internalizing and externalizing adjustment. Given prior studies' examination of family and cultural context as protective, parental warmth and acceptance may act as a salient protective construct among youth who engage in brokering. Additionally, prior literature has alluded to gender differences in outcomes for adolescents who broker, suggesting that how youth experience the adverse effects of brokering may be dependent on their gender. Given these gaps in the literature, the current study will examine the effects of language brokering on youth adjustment and whether parental support or gender moderates the association between brokering and youth adjustment. Participants were 547 Latino adolescents (Mage= 12.78, 55% female) who participated in a larger school-based longitudinal study in a new immigrant destination near Atlanta, GA. Surveys were completed on electronic devices every six months starting in 2018. Multivariate regression analyses were conducted to examine main effects of language brokering on adolescents' adjustment (internalizing and externalizing behaviors) and interaction effects of parental support and gender (language brokering x parental support, gender x parental support, language brokering x parental support x gender). Regression analyses showed significant main effects between parental support (time 1) and internalizing symptoms (β= -.12, p= .003) at time 2, but not for externalizing. Moderation analyses indicated that girls engaged in more language brokering at time 1 showed increased internalizing (β= -.09, p= .03) and externalizing (β= -.09, p= .04) symptoms six months later; this association was not significant among boys. There were no significant interaction effects involving parental support. Results suggest that the adverse effects of language brokering on adjustment outcomes is more significant for girls over time than boys, and that parental support did not buffer these effects. With continued immigrant family growth in the US, it is important for adolescent and family researchers to understand the potentially stressful role of language brokering given that parents often rely on youth in new immigrant destinations. Our findings suggest that interventions helping to reduce parental reliance on Latino youth for language brokering could reduce adjustment challenges, particularly for girls.

Social Sciences

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Tara Sinclair

ABSTRACT

Exploring the Consequences of Introducing Income Taxes on Economic Growth around the World

Tax collection is a fundamental role of the state in modern society. The introduction of new taxes allows states to enhance their capacity in global affairs and in providing domestic services. A new dataset provides information on when different categories of taxes (e.g. sales tax, inheritance tax, personal income tax) were introduced around the world over the course of 250 years. Almost every state around the world levies personal and corporate income taxes, accounting for a large portion of total state revenue today. The project seeks to find how the introduction of personal and corporate income taxes impacted macroeconomic factors utilizing historical population and GDP growth. With a particular bent towards questions of development, the project looks for differences in how developed and developing nations were impacted by the introduction of these new taxes. Population and GDP growth are seen as drivers for development and taxes must be considered as another piece of the development puzzle because of their impact on these factors. This project employs econometric methods to explore how growth is driven or impaired by the introduction of personal and corporate income taxes.

Social Sciences

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Elizabeth Chacko

ABSTRACT

Development and Demographic Change in Shaw and Columbia Heights, DC

In this research I analyze the impact which 21st century development projects have had on Shaw and Columbia Heights DC. These are both neighborhoods which have been celebrated for their history of diversity, but their communities are being increasingly affected by the impact of gentrification. I used Census demographic data and ArcGIS to analyze and map the extent and amount of change seen in DC, with a specific focus of these neighborhoods. Additionally, I conducted a photo essay to compare aspects of the current built environment to that of it years ago using archival photos from the Washington Historical Society and other sources. I also conducted informational interviews with community members and organizations in these neighborhoods to detail some of the qualitative changes seen by those living and working there. Past published research was also used to obtain information on the extent and timing of development projects in both neighborhoods. The results of this study show that the large development projects such as the Columbia Heights and Shaw metro stations and commercial/retail development in the early 21st century have shaped the economic status and racial makeup of both neighborhoods. The demographic shifts in Shaw began occurring slightly later, and have not been quite as stark as those in Columbia Heights, but the neighborhood has still seen significant change in the past decades. The increased median income, property values, rents, college educated population, and White population in both neighborhoods have been accompanied by a continued decrease in the Hispanic and African American populations. The photo essay showed that many of the changes to the built environment have come in the form of additions of non-essential services such as coffee shops and yoga studios, and at the expense of some of the more historic commercial businesses. Informational interviews with community members revealed that many people feel that the changes to the built environment and accompanying demographic shifts are due in large part to the development agenda set forth by the DC government. The changes in these neighborhoods show just a few examples of the kinds of shifts that are occurring in urban environments around the country. If neighborhoods like Columbia Heights and Shaw are going to protect their long-time community members, then protections to mitigate displacement by gentrification need to be added to development plans.

Social Sciences

Columbian College of Arts and Sciences

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Juliet King

ABSTRACT

Exploring Countertransference Reactions through Reflective Journaling and Art Making: An Arts Based Heuristic Study

Art making and journaling are often used with clients receiving art therapy, but little research has been completed on the use of these tools with countertransference reactions of the art therapist in training. The parallel process has been increasingly supported in the mental health field, encouraging introspection and personal therapy during the length of training. Art therapy can provide a unique form of parallel process allowing for access to unconscious transference and countertransference reactions that may arise during client encounters.

This heuristic arts-based research study explored the countertransference reactions of a training art therapist working with adolescent military dependents in partial hospitalization. The training art therapist took part in reflective journaling and mandala creation after group, individual, and parent art therapy. Surprisingly, treatment team encounters also seemed to elicit countertransference reactions and were included in the data. A total of 13 written entries and 13 watercolor mandalas were created during the length of this study. The Data from these entries were then evaluated and coded by the researcher and two external reviewers in order to identify recurring themes.

Thematic analysis of the written reflections revealed 3 major themes including 1) Acting as savior or parent, 2) Boundaries and personal disclosure, and 3) Personal and professional identity. The Great Round of Mandala, a structure for understanding the archetypal underpinnings and developmental life cycle of mandala creation, was used to assess the artwork created. Through this stage assignment process, it was found that the mandalas created aligned with the overarching themes discovered through thematic analysis. This heuristic study emphasized the importance of becoming aware of countertransference reactions in order to process subjective conscious and unconscious experiences and understand more about the therapist-client relationship. Furthermore, this understanding can be used to benefit this relationship and place the client in focus.   The twice weekly journaling and art creation proved to aid in awareness of unconscious countertransference reactions as well as sublimate emotional reactions as shown by repeated mandala stages as well as the emotional regulation experienced by the researcher. Further research on this topic could potentially support generalization of the importance of this process for training art therapists.

Social Sciences

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Steven Suranovic

ABSTRACT

Can German Cohousing Help Address the Middle-Housing Crisis in Arlington County?

There is a housing crisis in Arlington County, Virginia that as a complex problem, spans issues of unit affordability and scarcity, social equity, a lack of diversity in housing type, restrictive zoning, and both actual and potential speculative high-density development, sometimes called "vertical sprawl". With the development of Amazon HQ2 in Crystal City, there is increased pressure on community organizations, developers, and local government officials to develop alternative housing solutions to maintain the character of the neighborhood while modernizing services and increasing density. Arlington is addressing the study of affordable housing from an oblique angle, focusing its search on diversifying housing types in the region. This project tests whether the German cohousing type baugruppen could be a potential solution to the missing middle-housing crisis currently being addressed by the County Board in Arlington County, Virginia. This method of policy transfer evaluation or holistic policy evaluation, otherwise described as a policy viability assessment, employs a method of international policy transfer as a form of prospective policy evaluation. The policy transfer evaluation is joined by a classic financial viability assessment that is a traditional practice in the real estate sector. The analysis includes an Appreciative Inquiry (Ai) approach to information gathering, which focuses on identifying constructive solutions before applying intense critique to assess viability and is a cornerstone of the training provided in the Global Bachelor's courses. The purpose of this study is to demonstrate to community leaders in Crystal City that there are alternative models for community-oriented residential construction that are possible to explore in the face of Amazon's major plans to increase density and inflow workers for their new headquarters. The findings of this study identify the community factors necessary to facilitate the appropriate and successful implementation of the baugruppen cohousing model in northern Virginia. These factors have been outlined in a neighborhood diagnostic and include Neighborhood Management, a Participative Pre-Planning Process, Identification of a Flexible Construction & Design Team, and the Availability of Financing. This capstone research project was presented on Friday, February 28, 2020, at the 2020 Global Challenge Capstone Presentations for the graduating class of the Global Bachelor's Program. Funding for an additional phase of research for this project, which includes a site visit to Berlin, is being reviewed by the Global Bachelor's Committee on Tuesday, March 3, 2020.

Social Sciences

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ABSTRACT

Gaps in the Intelligence Community's Assessments of the Union of South Africa during the Eisenhower Administration and Their Relation to the Media, Academia and Policy

Throughout the Eisenhower Administration (although to a lesser extent after 1960), the intelligence and diplomatic community largely underestimated and ignored native resistance to apartheid policies leading to a partial intelligence gap, and thus ill-informed policy. Instead, analysts and policy-makers focused on minutia occurrences within white-minority government and short-term benefits of political balancing in the context of Eisenhower's limiting "international communism" lens. The international media somewhat followed a similar consensus with IC and policy-makers regarding the threat of communism (during the Second Red Scare) through the early 1950's, but as organized opposition became more prominent in the mid-late 1950's, coverage shifted largely to focusing on racial issues. This coverage influenced dissenting voices within Congress to take stances opposite to official US policy, further complicating Washington's relationship with Pretoria and undermining Eisenhower's balancing act. Academia's criticism of Eisenhower's policies largely ignore intelligence failure as a factor of this administration's decision making regarding South Africa. These findings stem from declassified US Intelligence documents and diplomatic communications, academic research papers and books, as well as archived newspaper coverage of relevant issues.

Social Sciences

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ABSTRACT

Social Support, Parental Stress, and Parental Self-Efficacy in Diverse Sample

Parental stress has been found to predict parental self-efficacy, which is the belief that one can execute a set of tasks related to parenting a child, with higher perceptions of stress corresponding to lower levels of parental self-efficacy. Social support has been identified as a potential buffer against parental stress and higher maternal self-efficacy is associated with higher parental support. Ethnic minority mothers are at high risk for parental stress. This current study investigates the relationship between parental stress and parental self-efficacy, and the mediating role of social support.

Our findings suggest that social support mediates the relationship between parental stress and parental self-efficacy among low-income minority mothers. Because social support was measured using co-parent social support, the more supportive the co-parent, the more likely this support will alleviate parental stress and increase the mother's parental self-efficacy. This research extends previous literature by studying a diverse, low-income community sample and by indicating that social support may be a protective factor in the development of low parental self efficacy. Future studies should employ a social support measure that includes social support provided extended family and friends when examining social support and its relation to parental stress, and parental self-efficacy.

Social Sciences

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ABSTRACT

Media and the Political Fear of School Shootings

With the rise of gun violence as a political fear and top campaign issue in recent years, it's imperative that we delve deeper into the pathways allowing this fear to fester. I ask: Does the media further political fears around gun violence and school shootings by overreporting school shootings as opposed to other kinds of gun violence? This question would be broken down into two parts: overreporting of school shootings and the creation of political fear. My theory is that the media sensationalizes and overreports on school shootings in a profit-driven attempt to capture the white, suburban media market. This is evident in the focus on school shootings, despite them being just a small fraction of gun violence in America. Everything about the way these shootings are represented is tailored to fit the needs of the media and pull at the empathy of viewers by focusing on the impact of innocent children. I utilized two research tactics to explore this hypothesis. First, a news analysis looking at how many articles about "gun violence" there are and compared it with how many mentioned "Parkland," "Columbine," or "Sandy Hook." The news analysis found that nearly ⅓ of news articles mentioning gun violence referenced one of the infamous school shootings, while less than 1% of gun violence actually comes from school shootings. I then did a survey experiment to test what effect each article had on respondents. The survey found that white respondents were likely to see a higher increase in fear of being impacted by gun violence after reading the Parkland article and had a higher percentage of people who were extremely likely to continue reading similar articles. My findings lead to the conclusion that the media is, in fact, overreporting on school shootings in a wildly disproportionate way. Additionally, my evidence shows that the mention of a school shooting in a white, suburban area is likely to induce fear of gun violence in white, suburban, middle to upper-middle class population. This leads us to believe that the media is sensationalizing the fear of gun violence by overreporting school shootings in order to capture the white, suburban media market. The main push for the political fear of gun violence is a profit-driven push by media elites to capture white markets and keep them consuming more media.

Columbian College of Arts and Sciences

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Irene Foster

ABSTRACT

Did Going Test Optional Increase Diversity in Economics Majors at The George Washington University?

The Economic Education Inclusion Index (EEII) ranks four year, not-for-profit public and private universities on a scale of 0 (no inclusion) to 100 (full inclusion) for diversity in economics. Between the years 2011 and 2015, The George Washington University (GW) received a value of 49.5, scoring in the 46th percentile. GW's test optional policy went into effect on August 1, 2015, thus creating space for important analysis on this policy's effectiveness in raising inclusivity in economics. I study whether the test optional policy had an impact on diversity in the economics department, specifically in economics majors, as well as students in the Elliott School of International Affairs, School of Engineering and Applied Science, and School of Business with a double major in economics, before and after the test optional policy went into effect. I define diversity as groups that have experienced historical underrepresentation, specifically females, and racial and ethnic minorities. Using IPEDS (Integrated Postsecondary Education Data System) and GW's Office of Institutional Research & Planning data, I study race/ethnicity/gender composition in the major from 2011 to 2019, conducting a difference in means test for pre and post test optional implementation. Since those applying test optional have not yet graduated, I study major once enrolled for first year undergraduate students and not at the time of graduation. Using Bayer and Wilcox's (2017) definition of full inclusion, I build on previous analyses of diversity trends at four year, not-for-profit, public and private U.S. colleges to evaluate if there has been an increase in inclusion at GW, and if that is matched in economics majors.

Social Sciences

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ABSTRACT

The Road Not Taken: Geographic Analysis of Informal Road Networks in Siberia

Large informal road networks, including paths, trails, and extraction industry easements, are used by indigenous Siberian populations such as Evenk communities around Lake Baikal. While not officially recognized or maintained by the government, informal road networks are crucial to local community livelihoods as they provide access to traditional subsistence hunting grounds, cultural sites, and other communities. In addition, these roads offer economic opportunities for geographically isolated populations. The complex relationship between the expanding Russian timber and hydrocarbon industries and the Evenk is further complicated as climate change threatens the continued use of these informal road networks. Permafrost (perennially frozen ground) underlying this region is susceptible to thaw, potentially leading to natural hazards including subsidence and washouts. To identify and evaluate areas of informal road networks at risk to hazards a map series was generated that documents the changing road network extent over time, and natural hazards to the road network from topography, hydrology, and permafrost thaw. High-quality satellite imagery available through Google Earth was used to digitize extent of recognizable informal roads within three study areas around the northern shore of Lake Baikal at four-time intervals: 1985, 1995, 2005, and 2015. The three study areas were selected to be representative of the region as a whole, including variation in topography and subarctic climate. The map series product revealed a gradual but nonlinear increase in road extent since 1985 across all three study areas and several areas at greater risk to natural hazards. This analysis indicates ways in which informal road networks change in response to evolving economic and environmental challenges.

Social Sciences

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ABSTRACT

The Cross-Lagged Effects of Positive and Negative Child Temperament on Positive Parenting in Early Childhood

Positive parenting refers to parenting behaviors such as warmth, acceptance, and responsiveness and is associated with better child mental and physical health outcomes. Research has shown that parenting behaviors and children's behavioral styles, or temperament, influence one another over time in a reciprocal fashion. This suggests that not only do parenting behaviors affect children, but child temperament also affects parenting behaviors. Research in this area has primarily focused on negative parenting, but given the long-lasting benefits of positive parenting on children's wellbeing, it is valuable to also understand the longitudinal relationships between child temperament and positive parenting. The current study aimed to determine whether there are reciprocal links between positive parenting and negative and positive child temperament from ages 3 through 5 years old. The sample consisted of 310 children and one of their parents participating in the longitudinal Boston University Twin Project study (2012-2018). Children's positive (smiling) and negative (anger) temperament and parent's positive parenting was assessed using self-report measures filled out by parents when the child was 3, 4, and 5 years old. Longitudinal effects of 1) Positive Parenting and Positive Child Temperament, and 2) Positive Parenting and Negative Child Temperament were each modeled using Autoregressive Latent Trajectory with Structured Residuals (ALT-SR) models. The majority of the parents in the sample were White (94%), married (97%), and college graduates (87%). Results indicated significant cross-lags linking child temperament and positive parenting over time. Positive Child Temperament at ages 3 and 4 predicted more Positive Parenting at ages 4 and 5, respectively (β =0.14; 95% CI, 0.04 to 0.24). Additionally, Negative Child Temperament at ages 3 and 4 predicted less Positive Parenting at ages 4 and 5, respectively (β = 0.24; 95% CI, 0.08 to 0.40). However, results did not suggest that Positive Parenting significantly predicted later Positive (β =0.14; 95% CI, 0.04 to 0.24) or Negative (β =-0.12; 95% CI, -0.19 to -0.05) Child Temperament. Overall, the results suggest that both negative and positive child temperament influence later positive parenting, but that positive parenting does not significantly predict later child temperament. It is important for parents to be aware of the ways their children's behaviors affect how they parent in return. These findings have valuable implications for parent-child interventions during this transitional period in the lifespan when a child's sense of security and wellbeing make them better prepared to navigate the increasingly more complex and social world around them.

Social Sciences

Elliott School of International Affairs

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ABSTRACT

Political Influence on the Placement of Opportunity Zones

Distributive political theory hypothesizes that political favoritism influences the allocation of distributive economic development policies or grants. This study assesses the relationship between the designation of Opportunity Zone and Contiguous Zone sites and legislators' party-identity. Opportunity Zones are the most recent iteration of place-based economic development policies intended to improve livelihoods and economic outcomes through targeted investment in low-income communities. Included in the 2017 Tax Cut and Jobs Act, the program provided governors from January – March of 2018 to select census tracts that would receive the designation. This selection process in 2018 provides a unique opportunity to test distributive political theory at the state level. Utilizing data from 42,176 eligible census tracts, this study will test if members in the majority party within a state receive a greater proportion of designated Opportunity Zones.

Social Sciences

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Amber Elizabeth Crunk

ABSTRACT

Vicarious Grief: Implications for Counselors-in-Training and the Supervisory Relationship

"Vicarious grief" is the phenomenon of experiencing grief on behalf of another person and is understudied in research. The impact of clients' vicarious grief on counselors-in-training and on the supervisory relationship will be explored in addition to relevant literature. Presenters will provide counselor educators and supervisors with recommendations for navigating vicarious grief in counseling.

Social Sciences

Graduate School of Education and Human Development

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Maureen McGuire-Kuletz

ABSTRACT

Intersecting Autism Spectrum Disorder and LGBTQIA+ Identities: An Investigation of Employment Outcomes

Individuals with Autism Spectrum Disorder (ASD) face unemployment at rates far outpacing the U.S. average by ten to twenty times. The likelihood of individuals with ASD identifying as part of the LGBTQIA+ community is also higher than that of the general population. Utilizing tenets of minority stress theory, we see that individuals with intersecting minority identities face increased symptoms of depression and anxiety, poorer mental health and employment outcomes, and higher rates of stigma and discrimination when they have marginalized racial and sexual and/or gender orientation minority group affiliations. George and Stokes also found similar outcomes for individuals with ASD who identify as part of the LGBTQIA+ community in terms of increased stressors and decreased mental health outcomes. This study analyzes the differences in employment outcomes as reported in survey data for individuals with ASD who identify as being LGBTQIA+ (n = 8) compared to the outcomes of those who identify as heterosexual (n = 49). Results show individuals with ASD who identify as LGBTQIA+ faced increased employment challenges in keeping with prior literature and multiple minority theory.

Social Sciences

Graduate School of Education and Human Development

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RESEARCH MENTOR/DEPARTMENT CHAIR

Sarah Shomstein

ABSTRACT

Trust in Human-Machine Interactions with Pupil Dilation

As technology becomes a more prominent part of human lives, trust in human-machine interactions is capturing interest of both industry and scientific communities. A 2017 McKinsey Global Institute study indicates that subsets of tasks and activities in almost all occupations can be automated, and approximately half of the paid workforce tasks can also be automated. Determining effectively human trust in a machine's output (or an algorithm) during human-machine interaction is critical to optimizing the potential of these systems. Limited, but on-going, research is being done to measure real-time trust levels in one-to-one human- machine interaction (HMI). While researchers have used psychophysiological measurements, electroencephalogram (EEG) or sensing real-time human trust levels in HMI, these tools are cumbersome and non-practical outside of the lab. Pupil dilation, a psychophysiological measurement, has been used to capture various cognitive states such as surprise and attention, is easier to measure than any other neurophysiological response. Applications of this approach to measure levels of trust during HMI could potentially be implemented with a simple mounted camera or even with a phone camera. We hypothesize that trust levels during HMI can be captured by measuring pupil dilation. This study captures participants' reactions while they observe performance of two simulated image recognition algorithms while the algorithms recognize cars from multiple images. One of the algorithms is sufficiently trustworthy as it recognizes cars correctly 80% of the time, and the other algorithm has an accuracy of only 60%. The main objective of this research is to examine whether pupil dilation is sensitive to differentiate between "sufficiently trustworthy" and "untrustworthy" algorithms. To test this hypothesis, 26 participants observed an algorithm performing a captcha type task in which the algorithm was to identify scene images that contained cars embedded in an array of 6 scenes. Pupil diameter was recorded throughout the experiment to capture participant's level of trust using the eye tracking system, SR Research EyeLink 1000. Our results show that participants' pupil size was significantly different when observing a trustworthy vs. a non-trustworthy algorithm. These results provide strong support that relatively simple technology (measuring pupil size) can be used to determine trust levels between humans and machines. This concept can be applied in various fields of applied artificial intelligence including human-robot and human-machine interactions and communications. Particular important areas include education (e.g., cognitive assistants in classrooms and support for massive online education systems), healthcare environments, workplace automation, and social interactions.

Social Sciences

School of Engineering and Applied Science

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ABSTRACT

Analyzing Airbnb's Effect on Rental Prices in American Cities Using Analysis Of Variance & Geographic Information Systems

Airbnb is one of the largest sharing economy platforms in the world, as it allows "hosts" in almost 200 nations to put their properties on a short term rental market. While Airbnb has been able to cut costs for some travelers, many argue that Airbnb takes units off the long term rental market that exists for area residents. This reduction in long term housing stock may exacerbate existing affordable housing crises in many cities. One-way analysis of variance (ANOVA) is used to test if Airbnb has a statistically significant effect on rental rates. The factor level used is Airbnb density, measured by the number of Airbnbs that are taken off the long term rental market divided by the number of total housing units in the corresponding census tract, and the response variable was the long term rental price growth over the previous four years. This research defines properties that are taken off the long-term rental market as those that are listed by hosts who have multiple properties, that are frequently available, that are recently booked, and that constitute an entire property. Geographic Information Systems (GIS) is used to analyze how Airbnb distribution intersections with the issue of poverty. Analysis is performed on an inter-city and intra-city level for 10 cities. Results show that Airbnb has no statistically significant effect on rental rates in American cities, but results also show that Airbnb is more dense in lower income areas.

Social Sciences

School of Media & Public Affairs

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Kim Gross

ABSTRACT

"Send Her Back!": The Effect of Nationalist Rhetoric on Political Attitudes and Identity

Nationalism is on the rise globally as evidenced by the Brexit campaign in the United Kingdom, and the election Jair Bolsonaro in Brazil. Consequently, this study examines the effects of nationalist rhetoric on political identity and attitudes towards immigration. Building upon theories of nationalism and social identity, it identifies three types of nationalist rhetoric: civic, open-ethnic, and closed-ethnic. It hypothesizes that overall, members of the ethnic or racial majority will show increased support for immigration when presented with the open-ethnic nationalism narrative (which stresses their continued ethnic dominance) as compared to the civic and closed-ethnic nationalism narratives (which stress their ethnic decline). Conversely, members of ethnic and racial minorities will show greater support for immigration regardless of the prime received, but will identify less with the party they deem exclusionary.

To test these hypotheses, an experimental survey was administered to 864 participants who were randomly assigned to one of four treatment groups to read a passage on immigration with either a civic, open-ethnic, or closed-ethnic prime. A series of experimental questions were asked following treatment exposure to measure attitudes towards immigration and political identity.

This study finds that civic nationalism narratives led to more positive attitudes towards immigration among whites and non-whites. Conversely, closed-ethnic nationalism narratives led to negative attitudes towards immigration and the Democratic party among whites and feelings of exclusion among non-whites.

These findings indicate that feelings of ethnic preservation or decline can influence attitudes towards immigration—challenging the commonly accepted notion of America as a civic nation.

Social Sciences

School of Media & Public Affairs

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ABSTRACT

Climate Change, Flooding & Framing in Midwestern and Northeastern Media

Flooding in the Midwest has become more severe during this century, and climate scientists have identified a link between localized extreme flooding and global climate change. Flooding in coastal parts of the Northeast has also increased in severity due to sea level rise and increased storm intensity, both of which are attributed to climate change. Awareness and acceptance of climate change among the public has increased, across categories of political ideology and geography, over the last three decades. This pilot study aims to analyze how coverage of flooding and climate change differs in Midwestern and Northeastern newspapers, particularly in Midwestern states considered red and Northeastern states considered blue. Newspapers included in this study are the Argus Leader (Sioux Falls, SD), the Omaha World-Herald (Omaha, NE), the Kansas City Star (Kansas City, MO), the Wichita Eagle (Wichita, KS), the New Haven Register (New Haven, CT), and the Providence Journal (Providence, RI). Through a content analysis of articles published between 1995 and 2019, the study examines the newspapers' usage of climate change framing in their reporting on flooding events. Preliminary findings suggest that while Northeastern newspapers have published a greater quantity of articles linking flooding to climate change, the articles published by Northeastern and Midwestern newspapers are of a similar quality in terms of the prominence of climate change in the article's structure and the intention with which climate change is referenced as a possible cause of flooding.

Social Sciences

School of Media & Public Affairs

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Kim Gross

ABSTRACT

Changing Minds on Climate Change Policy: Exploring the Effect of Value-Targeted Frames on Republican and Conservative Support for a Carbon Tax

Public opinion data has pointed to pervasive skepticism towards anthropogenic climate change (ACC) among Republicans and conservatives in the United States. Previous research on climate change communication, motivated reasoning, and framing effects reveals the difficulty of shifting such individuals towards acceptance of ACC, belief in its real-life consequences, and support for mitigation policies. At the same time, studies have demonstrated that certain culturally affirmative frames can increase support for mitigation policies among Republicans and conservatives. Building upon that research, this experiment explores whether Republicans and conservatives are more likely to support a carbon tax policy when its benefits are described using the value-targeted frames of economic opportunity and national security. My results show significant effects among Republicans and conservatives when exposed to the economic opportunity frame, but insignificant effects among those exposed to the national security frame. Moreover, the influence of the economic opportunity frame was only observed when compared to the control. Between-groups effects among the conditions who received a carbon tax editorial were largely insignificant. Overall, my experiment affirms that an economic opportunity message can sway Republicans and conservatives to support climate change mitigation policies, albeit to a limited degree.

Social Sciences

School of Media & Public Affairs

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Sean Aday

ABSTRACT

Prevalence of Substantive Policy in American Presidential Inaugural Addresses

The inaugural address is the starting line of a four-year marathon, a bold declaration of ambitions outlined on the campaign trail looking to be crystallized into concrete policy. These speeches are benchmarks in American history. Examples from Presidents Abraham Lincoln, John F. Kennedy, and Ronald Reagan defined their respective eras. They streamlined their own national visions into a single, cohesive address and distilled their proposals into rallying cries for the American people. As well as a longstanding tradition, inaugural addresses are also among the most visible events of the presidency. But what policy substance is mentioned or even affected during an inaugural? How does the subject matter of presidential inaugural addresses align with an administration's eventual executive and legislative accomplishments? Both political elites and the public at large heavily weigh the newly inaugurated, or newly reelected, president's words, but it is very possible that the speech lacks real meaning as it pertains to presidential priorities.

For the study, the author performed a content analysis of a stratified random sample of presidents, according to Korzi's (2004) categories. He developed the coding scheme and created 12 total categories that presidents have and could discuss in their inaugural addresses. For each of the randomly chosen presidents, the author analyzed their inaugural address as well as the closest subsequent State of the Union address, identifying substantive policy issues and recording an approximate word count for each one. The word count is intended to calculate the intended magnitude of the topic, the importance that the president is trying to assign to it. One measure the author implemented was recognizing a 10-word margin of error for every word count. After calculating the word count for each category in all of the selected inaugural addresses and States of the Union, the categories and word counts will be ranked for each individual speech. The rankings will then be compared between the two with a one-ranking margin of error.

All of this data seems to preliminarily indicate that issue replicability is increasing over time, but magnitude replicability is much more variable. Therefore, it can be concluded that inaugural addresses are not likely to contain substantive policy that will affect the priorities and accomplishments of a president's administration.

Social Sciences

School of Media & Public Affairs

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Kimberly Gross

ABSTRACT

The Effects of Probabilistic Forecasts and Policy Stakes on Electoral Participation in an Experimental Setting

In my study, I looked at the effect of probabilistic forecasts and policy stakes on vote intention in an experimental setting. To do this, I simulated a local mayoral election and exposed subjects to mock newspaper articles giving information about the policy stakes of the mayoral race and probabilistic forecasts about which mayoral candidate was more likely to win. In this experiment, I found that varying the policy stakes of an election had a significant impact on intention to vote - when the candidates disagreed on a major policy issue in the high stakes treatment, subjects were significantly more likely to indicate that they would vote in that election in comparison to the low stakes treatment, where subjects were told that the two candidates agreed on that same policy issue, and the control treatment. On the other hand, varying probabilistic forecasts did not have an effect on intention to vote in the mayoral experiment - making the race more competitive probabilistically did not make subjects more inclined to vote than if the race was less competitive probabilistically or subjects were exposed to the control treatment. Both stakes and probability had some effects on candidate favorability and candidate preference in my mayoral experiment. In a separate experiment, I exposed subjects to mock newspaper articles about the 2018 U.S. Senate election in Arizona between Kyrsten Sinema and Martha McSally. In the Arizona experiment, I found that low stakes made subjects significantly less likely to say they would vote in comparison to the control treatment. My results lead me to conclude that the media has the potential to influence political participation levels through the way they cover elections.

Social Sciences

School of Media & Public Affairs

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ABSTRACT

Cumulative Effects of Viewing Conventional Casualty Images Upon Public Opinion of American Involvement in Foreign Conflicts

In this study, I will be examining the cumulative effect of viewing conventional casualty images upon public opinion regarding war. A conventional casualty image is one that does not feature gore or battlefield action. These often include images of military funerals and flag-draped coffins. Journalists most typically use these types of images when coving war. Prior research has shown that viewing this type of casualty image tends to decrease general support for war, though this is filtered by partisanism with the effect being stronger among Democrats than Republicans (Gartner). The effect of viewing these images has not been measured cumulatively over time. I will use my experiment to attempt to fill the gap in this research. Four test groups will view images in this study including a control group, a single-day, single casualty image test group that will view an assortment of innocuous images and one casualty image, a single-day, multiple casualty image test group in which subjects will view an assortment of innocuous images and an assortment of casualty images, and a multi-day trial in which subjects will view a collection of innocuous images and one casualty image in three consecutive days. I expect to find significant changes in public opinion between the control and single-day, single image test group, with subjects who viewed casualty images favoring war less. I also expect this effect to be the same for the single-day multiple image group, but larger among the multi-day group. These results would not only confirm earlier research but add to the existing body of research by showing that repeated exposure to casualty image--like what people may see during war--could compound the effect, meaning current scholars may be underestimating the extent to which war images decrease public war support.

Social Sciences

School of Media & Public Affairs

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Kim Gross

ABSTRACT

Media Framing of Nuclear Energy

The vast majority of climate scientists agree that we will need to reach net zero carbon emissions in the next 30 years if we want to avoid the worst effects of climate change. At the moment, around 80 percent of energy in the United States and 85 percent of energy worldwide is derived from carbon based fuels. Those who are seriously interested in stopping climate change must focus on finding a viable carbon replacement.

Currently, there is only one zero-carbon energy source capable of meeting worldwide energy demand: nuclear. Any climate change policy that hopes to meet the aggressive goals laid out in the 2018 IPCC report must include nuclear as at least part of the solution. Yet, even as Americans concern about climate change climbs, their opinions of nuclear power remain lukewarm at best.

What shapes Americans opinions of nuclear power? Literature suggests that media coverage may play an important role. Nuclear energy production is not something most Americans have firsthand experience with. Further, it is not a heavily partisan subject. Without personal experiences or party cues to shape their opinion, Americans opinions of nuclear power are likely shaped by how the media framing in news coverage.

How does the media cover nuclear power? In 1989 Gamson and Modigliani published a study that identified and analyzed media framing of nuclear energy from Hiroshima to the late 1980s. Their analysis spanned four different types of media and was broken down into three different time periods. However, no authors to date have attempted to update or expand upon their results. This project attempts to fill this hole in the literature.

Drawing on Gamson and Modigliani's design, this project will consist of a content analysis to determine what frames are most prevalent in modern day coverage of nuclear energy. The analysis will span from January 1, 2010 to January 1, 2020 and cover the New York Times, Wall Street Journal, Washington Post, and USA Today. The resulting data will help us to better understand the standing of nuclear energy in American public opinion- a crucial first step in increasing its popularity, and eventually its production, in American politics.

Social Sciences

School of Media & Public Affairs

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Kim Gross

ABSTRACT

The Role of Gender In Twitter Harassment of Journalists

Since the advent of social networking, journalists have been utilizing sites like Twitter for gathering information, promoting their stories, and interacting with their audiences. With this increased access, journalists have reported facing abuse and harassment online. Research over the past decade has shown that women-identifying journalists receive a higher amount of abusive content compared to men, despite the efforts of advocacy organizations and news publications to protect their journalists (Hess, 2017). This study investigates the current state of problematic content directed towards journalists on Twitter, and demonstrates the need for further interviews and testimonies from women journalists. Using the Social Feed Manager, a social media collection software provided through Gelman Library, I studied a sample of 36 U.S. political journalist's tweets over a week period, coding for problematic content. There are 18 women and 18 men in the sample, coming from both legacy print and TV outlets, and ideologically-leaning print and TV outlets. These journalists proved to be prolific in political coverage in the month prior to this study, and have a high amount of Twitter followers, relatively compared to other journalists from their same publication. I hypothesized that women received a higher percentage of problematic replies and mentions than men. Problematic content was analyzed and categorized into seven different issue-areas: sexist/misogynistic content, sexually threatening content, threating content that was not sexually motivated, homophobic or transphobic content, racist or ethnically-discriminatory content, and other offensive content that did not fit it into one of the before specified areas.

The content analysis showed that the amount of harassment each journalist received depended largely on how active this journalist was on Twitter, and the results proved that Twitter followers was a stronger indication of the likelihood to receive problematic content than gender. Many of the tweets analyzed in this study, while they were in reply to a journalist and used their direct username, on average were more likely to pertain to the content of a journalist's coverage as opposed to be directly referencing the journalist themselves. The results of this study stand in contrast to past research that has proved women receive more online abuse than men, and this shows that a content analysis of tweets will not suffice to investigate the issue of women journalist's online harassment. Abusive language and harmful or threatening content could also be transmitted via direct message or email, and to study this, researchers will need to interview women journalists and listen to their stories.

Social Sciences

School of Media & Public Affairs

PRIMARY PRESENTER

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Kimberly Gross

ABSTRACT

Polarizing America: Social Media and Political Extremity

This study explores the relationship between online political content and political polarization. There is a growing ideological divide between conservatives and liberals on matters of policy, as well as a rise in animosity between members of the two major American parties. The present study asks whether exposure to partisan social media posts affects the intensity of individuals' political beliefs, as well as their attitudes toward opposing partisans. Participants recruited from Amazon Mechanical Turk were randomly assigned to one of two experimental conditions—anti-Republican or anti-Democrat—while the control group viewed posts that did not concern politics. Each post included a meme—an image with text superimposed—as well as short captions that mirror actual posts on Facebook. After viewing the posts, participants answered a series of questions about their issue positions and their opinions regarding members of the opposing party. We found that those who viewed the partisan posts did not exhibit more extreme political opinions, nor did they exhibit greater animosity toward members of the opposing party. This was true regardless of individuals' self-reported party identification. These findings suggest that exposure to political content on social media, at least in the short term, does not have a polarizing effect on individual users. Future research might examine whether the same is true for exposure to partisan content over time, or whether engagement with this content—by "liking" or "sharing," for example—has a reinforcing effect on political attitudes or behaviors.

Social Sciences

School of Media & Public Affairs

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Kimberley Gross

ABSTRACT

How Consistent Viewing Effects Indifference Towards Police Misconduct

Social media has opened the information floodgates, allowing for geopolitical news and domestic turmoil to be interspersed with pictures of family and friends.   One issue that has been made prominent by social media use is police brutality. The Black Lives Mater movement led to a wave of criticism of police practices in the United States, but research shows that views toward police are more positive than they were in the immediate aftermath of Ferguson. On the other hand, there has been an increase in access to videos documenting police misconduct as a result of citizen videographers and body cameras. How might an increase in viewing of videos of police misconduct shared on social media influence views and opinions on policing and reactions to police misconduct?

In order to understand the potential influence of sharing these videos, this project examined whether there is a relationship between how many videos of police misconduct that subjects watch and their feelings towards police misconduct. Subjects view online content like what is generally found on YouTube or on social media. Specifically, they are exposed to either: (1) three videos showing police misconduct; (2) one video showing police misconduct or (3) no videos showing policy misconduct (the latter, the control condition instead features videos on innocuous topics like cooking, journaling and cute animals. Findings showed that both hypotheses were untrue and found no statistical significance between viewership of police videos and negative or positive police opinions. There was an agenda setting capacity found, but it was overall minimal.

Social Sciences

School of Media & Public Affairs

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ABSTRACT

The Efficacy of Mitigating YouTube Disinformation with Government Funding Disclaimers

State produced disinformation has been a primary topic of concern in political communication following the 2016 Presidential election. Much of the research, media attention, and platform resources have been focused on the disinformation tactic known as coordinated inauthentic behavior, where networks of bots and trolls are deployed to masquerade as members of a foreign populace. However, disinformation disseminated by state-owned media networks has the potential to be far more harmful. Earlier this year, as tension between the United States and Iran escalated, Russian owned social media channels gained millions of views pushing videos that criticized US policy. These types of media sources are allowed to remain on most major social networks without disclosing their affiliations. Ensuring that viewers are informed of the state that is funding the content's production is essential for creating a healthy online discourse.

In pursuit of this goal, YouTube has taken the approach of labeling state-owned media as such below the video. It remains unclear however, whether this is an effective strategy, or an empty gesture aimed at appeasing potential regulators. Previous literature suggests it may be possible to mitigate disinformation with disclaimers but that first the funding disclaimer must overcome the cognitive barriers identified by Kahneman and others that may prevent participants from noticing it. For example, Chabris and Simmons identify inattentional blindness, where focus on the video will prevent participants from absorbing the disclaimer. This article presents a four-condition study seeking to answer whether in their current state the YouTube disclaimers are able to overcome these cognitive barriers and mitigate disinformation. Participants were exposed to either a control video, an RT without a disclaimer, an RT video with the current form of the disclaimer, or an RT video with custom superimposed disclaimer. Following the survey participants were asked a series of questions on their opinions on everything from feelings about Russia to spending on defending against Russian interference. Pilot data suggests that in its current implementation the YouTube funding disclaimer is ineffective in mitigating disinformation as it produces no effect in participants' beliefs that RT is funded by Russia. Research from Pennycook et al. suggests that the superimposed version will produce measurable belief shifts where the real version fails to. The final results of this study will enable YouTube and other social media platforms to more effectively respond to state produced disinformation.

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ABSTRACT

Comparing Media Coverage of the Christian Left and Christian Right in Frequency and Power Portrayals

The 2020 American elections cycle has brought a new spotlight upon the "Christian Left". Likely spurned in part by the rhetoric of candidates like Mayor Pete Buttigieg, but also by new movements (such as William Barber's Poor Peoples' Campaign), mainstream media coverage of the Christian Left has increased. This is not the first time that news media coverage of the Christian Left has surged. Yet, each time these coverage surges occur, the Christian Left is repeatedly described as a new, latent, or resurfacing political entity. Meanwhile, the Christian Right is generally perceived as an established entity and potent pollical force. Past scholarship regarding these two movement has skewed heavily towards the Christian Right. Far less scholarly attention has been devoted to the Christian Left and to date no work has compared media coverage of these two movements. This research aims to find what differences, if any, exist, both in terms of the amount of media coverage, as well as the character of that coverage devoted to the Christian Left and the Christian Right. To achieve this, a content analysis of print media articles from three major U.S. publications (The Washington Post, New York Times, and Wall Street Journal) will be conducted. The expectation is that the results of this analysis will reflect a far higher degree of coverage dedicated to the Christian Right, but also that the news media tends to cover the Christian Right as more powerful and influential than it does the Christian Left. Such findings would provide supporting scholarship to the previously unestablished assumption that significant disparities in both coverage and media perceptions of influence exist between these two entities. This might point to new questions of media effects, effects that could point to the creation of perception gaps between the Christian Right and Left. Having established this, further research can look into the subsequent questions of how and why these disparities exist and provide a necessary impetus for further research into the Christian Left.

Women/Child Health

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ABSTRACT

A Phenomenological Inquiry into Black Women's Birth Experiences: A Black Feminist Perspective

Black women experience a number of systemic racial and gender related disparities that ultimately in?fluence some of the worst health outcomes in the United States. Institutionalized gendered racism has been shown to influence all areas of lived experience, and can particularly lead to disproportionate stress levels for Black women. As Black women undergo increased psychological and physical stress, this allostatic load can lead to chronic illness and poor health outcomes.

One issue that has gotten more recent attention is the staggering statistic that Black mothers in the United States are 3-4 times more likely to die from childbirth. This study will use the Black Feminist perspective to understand this phenomenon of how multiple oppressive factors come into play for Black women's birth experiences. Ten to twelve Black women in Washington, DC are interviewed about their most recent birth experience(s), audio- recorded, and transcribed. The interview transcript is qualitatively analyzed employing phenomenological analysis.

Emergent themes describing shared experiences are explored and discussed. Additional areas of inquiry include: mode of delivery, utilization of healthcare professionals, insurance access and cost, social support, gendered racism, and action-based solutions to improving services and experiences. By analyzing the birth experiences of Black women told by themselves directly, we may identify potential solutions and equitable best practices for improving maternal health outcomes. These solutions can inform community-based efforts in intervention and policy.

Women/Child Health

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ABSTRACT

Clarification of the Nutritional Composition and Related Evidence For Nutritious Food Supplements in Pregnancy for Undernourished Women

As the evidence showing the benefits of nutritious food supplements in pregnancy has grown, new products and related research has emerged. Along with these advances has also come some confusion around product-related terminology and difficulty in synthesizing and comparing the evidence base. The objective of this study is to define specific categories of nutritious supplemental food for pregnancy, review the nutritional composition and evidence for these products, and summarize the evidence.

We identified relevant studies by doing an umbrella review. For each study, we abstracted data about the nutritional composition of the food supplement, as well as the trial results. To identify ongoing studies, we searched ClinicalTrials.gov and the International Clinical Trials Registry Platform for "Balanced Energy Protein," or "Lipid Nutrients."

Over the last 4 decades, 17 trials including 9030 women have assessed the safety and efficacy of balanced energy and protein (BEP) supplementation during pregnancy. There is considerable heterogeneity in the nutritional composition of products used in the trials. The daily food supplement tested in trials ranged in calories from 59 kcal to 1500 kcals. The macronutrient composition averaged 66 kcals of protein and 16 kcals of fat. There was variation in the vitamin and mineral content of the supplements. We identified three new studies that will test BEP supplements with standardized macronutrient and micronutrient composition.

Despite heterogeneity in the nutritional composition of BEP supplements in previous trials, there is clear evidence that nutritious food supplements for undernourished women can improve birth outcomes. New trials, based on standard product formulations with the potential for scale-up will provide additional evidence and a path forward for implementation.

Women/Child Health

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ABSTRACT

Religion as a Predictor of Maternal Mortality: A Case for the Apostolic Church Denomination in Zimbabwe

A significant amount of recent scholarship has examined the interconnections between health and religion, decisively confirming their inseparability. A major contemporary African theology, for instance, emphasizes the dynamic relationship between health and religion, investigating particularly how religion (for better or worse) can impact people's health. The purpose of this research was to investigate how religion acts as both a contributor and predictor of maternal mortality in Zimbabwe, specifically in the ultra-conservative Apostolic Church denomination. The second aim was to show how the Apostolic Church's doctrine violates the first component of the three-delay model, which is deciding to seek appropriate medical help for an obstetric emergency. Within this denomination, women are prohibited from utilising modern health services or medicine, which obstructs health-seeking behaviors, putting women at risk of death. Engaging religious discourse when examining maternal mortality further enriches the area of Maternal and Child Health because it allows public health practitioners to use a multi-disciplinary approach to create culturally appropriate interventions.

Women/Child Health

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ABSTRACT

Evidence for the Need to Revise the Rotterdam Criteria for the Diagnosis of Polycystic Ovarian Syndrome

Polycystic Ovarian Syndrome, also known as PCOS, is a hormonal disorder in females characterized by symptoms caused by increased levels of androgens, or hyperandrogenism. In PCOS, the increased levels of androgens in females cause irregularities with menstrual cycles, increased facial and body hair, infertility, type II diabetes due to insulin resistance, obesity, mood disorders, and endometrial cancer. PCOS is also the most common endocrine disorder among women between the ages of 18 and 44. Though common, it remains undiagnosed and unmanaged in most women of reproductive age. When unmanaged, it can cause life-threatening symptoms, such as worsening type II diabetes, uncontrolled high blood pressure, heart disease, and fatty liver disease. PCOS also has a significant effect on women's self-esteem and mental health due to unwanted facial hair growth and increased weight gain.

The Rotterdam Criteria is currently used to diagnose this disease, but fails to include or specify several symptoms of PCOS that are prevalent in many women. Moreover, the criteria used in the Rotterdam guidelines can often be absent in women who still show evidence of PCOS upon imaging. In order to increase the detection of this disease and provide proper diagnosis, treatment, and management options to women, a new list of criteria must be developed for healthcare providers. Though the number of women diagnosed with PCOS has been rising for the past decade, it is estimated that thousands of women are undiagnosed in the United States alone, due to the rigid criteria imposed by the Rotterdam guidelines.

By implementing the additions and changes proposed in this study to the Rotterdam criteria, women can receive a formal diagnosis for PCOS and begin proper care and management for the disease before comorbidities arise. Further studies should look into why symptoms of PCOS have such great variability among women, and whether or not this is tied to environmental or genetic factors.

SPECIAL PRIZE CATEGORIES

The following presenters submitted their abstracts for the following categories:

Equity, Diversity, and Inclusion Prize

Hewan Abera	Gavin Derleth	Monica Iskander	Soolim Park	Max Skidelsky
Shontrice Barnes	Okechuku Enyia	Min Jeong Jeon	Nithya Prakash	Elizabeth Smith
Trinity Bell	Stephanie Erwin	Breya Johnson	Stephanie Purwanto	Briana Spainhour
Sivan Ben-Maimon	Janay Ezekwe	Nicole Kelly	Yuqing Qiu	Gabriella Spencer
Nana Boateng	Raquel Gerard	Aneka Khilnani	Akea Robinson	Alexia Stefanovich
Taylin Bower	Colleen Grablick	Jace Knie	Giuliana Rodriguez	Maera Stratton
Rachael Brady	Jonathan Grima	Kimberly Krane	Craig Roey	Margaret Swenson
Elizabeth Brownstein	Wei Guo	Zaniya Lewis	Richard Sear	Jacob Tafrate
Alexandria Cannon	Moses Hinton	Melody Magly	Arzoie Sharma	Rachel Talbert
Xiaocun Chen	Bo Hundley	Hayley Margolis	Elizabeth Sheppard	Lashanah Thomas
Lauren Chi	Katherine Hurley	Bri Mirabile	Lindsey Siff	Benjamin Turley
Patrick Corr	Aisha Hussain	Kayley Nagle	Rachel Simon	Olesya Van Dijck
Paromita De	Ans Irfan	Akshat Pandey	Aditya Singh	Matthew West

Women's Rights and Gender Equality Award

Hewan Abera	Wei Guo	Li Liang	Craig Roey	Kiara Stewart
Shontrice Barnes	Moira Honohan	Hayley Margolis	Arzoie Sharma	Mouni Talari
Paromita De	Katherine Hurley	Kristin McGinty	Abigail Sharp	Lashanah Thomas
Stephanie Erwin	Aisha Hussain	Bri Mirabile	Elizabeth Sheppard	Abhijai Tibrewala
Janay Ezekwe	Chioniso Jakazi	Kayley Nagle	Elizabeth Smith	Olesya Van Dijck
Raquel Gerard	Breya Johnson	Michelle Nguyen	Gabriella Spencer	Hagere Yilma
Colleen Grablick	Zaniya Lewis	Stephanie Purwanto	Alexia Stefanovich	

The Nashman Prize for Community Based Participatory Research

Hewan Abera	Chayna Hardy-Taylor	Caroline Malone	Munshi Md Rasel	Olesya Van Dijck
Kunj Bhatt	Sam Kerry	Rui Miao	Abigail Sharp	Justin Williams
Benjamin Bowman	Aneka Khilnani	Ji Min	Jacob Tafrate	
Caroline Casey	Zaniya Lewis	Jillian Morgan	Lashanah Thomas	
Shannon Doyle	Hongyu Liu	Naiya Osiyemi	Abhijai Tibrewala	
Janay Ezekwe	Fiona Lupi	Destie Provenzano	Benjamin Turley	

GWNIC Award for Microscopy and Nanofabrication Techniques

Annika Balraj	Jennifer Giaccai	Noah Lubin	Anna Ren	Ryan Welch
Emily Cheung	Vanshika Jain	Sofian Obaid	Md Abid Shahriar Rahman	
Kaitlin Garofano	Regina Komal Kottana	Natalie Orsi	Jinbi Tian	

AccelerateGW I-Corps Grant

Obumneke Amadi	Stephanie Erwin	Nisha Kapani	Satish Kumar Noonepalle	Briana Spainhour
Cyrus Behzadi	Nicole Frost	Anna Lewek	Yaprak Ozakman	Mouni Talari
Trinity Bell	Tracy Fu	Hongyu Liu	Devarshi Pandya	Malvis Tamon
Nana Boateng	Javid Ghaemmaghami	Celine Mahne	Soolim Park	Lashanah Thomas
Nicole Bonan	David Goldsmith	Hayley Margolis	Soniya Phatak	Kristen Tuosto
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Christian Delgado	Chioniso Jakazi	Amanda Moyer	Teah Serani	
Sara Maria El Oud	Haley Jetter	Shruthi Shree Nagarajan	Mariia Sidulova	

Sustainability Prize

Farhana Alam	Ans Irfan	Marisa May	Christopher Reid	Malvis Tamon
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Chayna Hardy-Taylor	Kgomotso Madisa	Swetha Ramesh	Gabriella Spencer	Ryan Welch
Mahmudul Hasan	Monique Martinez	Brenna Reach	Jacob Tafrate	Emily Youner

OVPR Cross-Disciplinary Award

Sarah Beebe	Mattingly Gerasimovich	Jason Katz	Jose Nazario Costa	Abigail Sharp
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Sara Maria El Oud	Helen Ibeawuchi	Kgomotso Lenah Madisa	Giuliana Rodriguez	Abhijai Tibrewala
Okechuku Enyia	Ans Irfan	Andrew Magie	Craig Roey	Matthew Tovar
Stephanie Erwin	Chioniso Jakazi	Hayley Margolis	Md Abid Shahriar Rahman	Kerrigan Unter
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