# Ronald E. McNair Achievement Program

# Ivan Vo

## "Nrf2 Inhibitors as a Potential Cancer Treatment"

ABSTRACT: Nrf2 Function as Chemopreventive Compounds and Chemoresistance

Nuclear factor erythroid 2-related factor 2 (NRF2) is a transcription factor and the master regulator of antioxidant response. This mechanism protects against oxidative stress and promotes cell survival. The role of NRF2 in cancer prevention and treatment is complex due to its duality. NRF2 is required in protecting the healthy cells of the body by binding to the antioxidant response element (ARE) of its target genes and producing beneficial proteins, which enables cellular survival. However in some cancer cells, due to mutations or other cellular events NRF2 stays constitutively active, resulting in the promotion of cancer. A NRF2 inhibitor is needed to overcome the constitutive activation of NRF2 in cancer cells and for further research. This study focuses on developing compounds that could inhibit NRF2 function, and decrease cancer cell survival. Several NRF2 inhibitor compounds were developed and tested on p53 deficient cancer cell line H1299. H1299 cells were treated for 4 or 16 hours and the expression levels of NRF2 and its target genes were determined with Western blots. Surprisingly there was an increase in NRF2 protein levels, however most downstream proteins (NQO1, GCLM, P62) were downregulated, resulting in decreased cell survival. The current results suggest that not only NRF2 inhibition with current compounds prevent NRF2 degradation but also NRF2 function is decreased. Further research in needed to identify and characterize the inhibition of NRF2 function in cancer cells and also prevent cancer cells survival.

# Sarah Jacquot

## "A User Study on Visualizing Gantt Charts"

ABSTRACT: Gantt charts are commonly used for visualizing execution traces in parallel processes. Examining and understanding these execution traces become important for performance debugging and general comprehension of program fluidity. As complexity grows we are faced with algorithms that create hundreds of processes raising the question of how to effectively display this data. The study addresses the question of whether the current methods for visualizing Gantt charts, specifically in relation to execution traces, are effective by conducting a user study using multiple choice questions and grid drawing questions. We conducted a pilot study in which subjects answered a series of question regarding visualization patterns in Gantt charts to investigate whether these visualization patterns were intuitive to users in their present form. We are currently in the process of analyzing the data from our pilot survey to be able to better narrow down the types of questions to use moving forward into the final study. We plan to run this study again at Supercomputing Conference 2018 to get participants with diverse programming backgrounds to effectively analyze if users can easily understand and interpret visualization patterns.

# Sarah Sylvester

**“Evaluation of Corruption Strategies within the Philippine Development Plan”**

ABSTRACT: The Philippines possesses a vibrant history of elitist power, martial law, and constant reach for improved governance. The influence of its past through various institutions continues to affect the current economy and protect corruption within the government. To better improve the lives of Filipino citizens and ensure a flourishing economy, goals for the country were recently established in the Ambisyon Natin 2040. Through a mixture of citizen input and interdisciplinary government work, the Philippine Development Plan (PDP) was created, containing strategies designed to improve various institutions over 25 years. Part II of the PDP 2017-2022 centers on improving trust within the country, accomplished in part by lowering corruption. The current study attempts to understand whether or not the strategies listed in the PDP will be successful in reaching the desired outcome, and if so, to what extent. This is being accomplished by analyzing past attempts to eliminate corruption as well as the present plan, while carefully considering the impact the Philippines’ past will have on the PDP’s success. Studies measuring corruption, including those conducted by Transparency International (2017) and the Office of the Ombudsman (2014), are utilized to estimate the effectiveness of the PDP. The PDP not only influences the Philippines, but could also serve as an indication of the success of similar or future plans in different countries.

# Samantha Serna

## "Examining MRP4 as a Potential Target for Vascular Protection in Stroke"

ABSTRACT: The blood brain barrier (BBB) is disrupted under pathophysiological stressors such as ischemic stroke where the body is deprived of glucose and oxygen. Such BBB disruption can contribute to neuronal cell death and cerebral edema. To protect against breakdown of the BBB in the setting of ischemic stroke, the multidrug resistance protein 4 (MRP4) has become significant as a possible therapeutic target (Brzica et al. 2017). MRP4 is an active efflux transporter of substances such as the endogenous antioxidant glutathione (GSH) (Ronaldson & Bendayan, 2008). Under hypoxic stress conditions, MRP4-mediated efflux of GSH is enhanced, an effect that can contribute to BBB disruption (Ronaldson, P.T., & Davis, T.P. 2015). The current study focuses on characterization of MRP4 localization and functional expression at the BBB in Sprague-Dawley rats. Sex is a significant biological variable that impacts stroke therapy (Appelros, P., Stegmayr, B., & Terent, A. 2009), therefore all studies will be conducted in male and female experimental animals. Since preliminary data from our laboratory indicates increased MRP4 expression in female rats as compared to male rats, we hypothesize that significant differences in MRP4 localization, expression, and function exist based on sex. Current studies in the laboratory are focused on confirming MRP4 protein expression at the BBB via western blot analysis and MRP4 localization in rat brain microvessels by confocal microscopy. These studies are significant because they will establish sex differences in transporter functional expression, thereby providing critical insights into development of personalized medicine strategies to target MRP4 for stroke therapy.

# Veronica Lugo

**“Exposure and Nutrition in an Arizona Tribe”**

ABSTRACT: Within an Arizona Tribe, prevalence of obesity, diabetes, and cardiovascular disease has increased. Previous studies elaborate on food insecurities within rural American Indian reservations leading to lack of fresh food and lack of resources for tribal members (Bauer et al., 2012). The objective of this study is to evaluate the nutritional intake of Tribal members and determine the most common food consumption that has led to obesity, diabetes, cardiovascular disease, and other adverse health effects. To do so, this study examined on forty-one houses within the Arizona Tribe and targeted one member of the household to collect their dietary intake. A 24 – hour dietary recall (via questionnaires) for respondents to provide nutritional reporting on daily meals which will then be divided into specific food categories along with records of food frequency (Willett, 1998). Thus, data is still being analyzed for individual household reports and communal Tribal report. Currently, fourteen households have data collected for further analysis. At the end of the study, the Tribal council will receive the communal results and each household participant will receive personalized results. Further studies must be conducted to evaluate food quality within this population. These data will be specific to the household member and educational interventions will be implemented to help promote healthier food options and modify traditional dishes to reduce health risks within the Arizona Tribe.

# Nathan Gallegos

## "White Matter Integrity of the Corticospinal Tract and the Resting Motor Threshold"

ABSTRACT: Transcranial magnetic stimulation (TMS) enables neuroscientists to study the brain by exciting or inhibiting specific brain regions with high precision. TMS shows promising results in those diagnosed with depression seen in reducing some of the symptoms experienced by reducing the activity in Default Mode network that is seen to have decreased activity in depression1, 2. A primary measurement derived from TMS is the cortical excitability, which is the quantitative measurement of the inhibitory and excitatory balance in the brain resulting in the resting motor threshold (rMT). Meanwhile, Diffusion Tensor Imaging (DTI) is used to assess the health of the white matter of the neurons in the brain before and after TMS treatment. One key DTI measurement is the fractional anisotropy (FA), which measures the overall directionality of the water molecules' movement within the white matter of the neurons. Furthermore, the relationship between DTI measures (FA) and the cortical excitability (rMT) has not been well studied. Therefore, using these means of measurement this investigation attempts to analyze the relationship between the rMT and the FA of 15 cognitively healthy older adults (age range = 65-75 years, mean 70). During the TMS procedure, a visual confirmation of a finger movement in the contralateral hand will serve as a sufficient pulse needed to generate a movement. These relationships will be observed in the corticospinal tract which relays information from the brain to the body for motor commands.

# Osvaldo Villa

## "Age-related Increase in Lymph Node Fibrosis: Targeting Profibrogenic Pathways"

ABSTRACT: Lymph nodes (LNs) are centers of adaptive immune response that contain populations of naïve lymphocytes. The expansion and differentiation of naïve lymphocytes in the LNs provide specialized, long-lasting defense against infections. Therefore, the structural and functional integrity of LNs is critical for proper immune response. However, age-related changes in LNs such as a decrease in LN structure and cellularity, as well as advanced fibrosis are factors that may be responsible for the deteriorated immune response in older adults (Thompson et al., 2017). Fibrosis occurs in response to tissue damage and is characterized by excessive accumulation of extracellular matrix (ECM) and collagen at the site of tissue injury (Wick et al., 2010). Interleukin-7 (IL-7) is a growth factor that stimulates survival and proliferation of naïve lymphocytes (Link et al., 2007).

In this study, we propose that collagen deposition and increased LN fibrosis hamper T naïve access to IL-7, leading to the premature death of naïve T lymphocytes. An IL-7 protein solution is injected into old and adult C57BL/6 mice and the T naïve cellularity of their LNs are analyzed 7, 10, 14, and 21 days after treatment using single cell suspension, general cell count, and flow cytometry. Preliminary data shows the treatment was effective in significantly increasing lymphocyte cellularity in old IL-7 treated mice superficial LNs at 7, 10, and 14 days after treatment. Flow cytometry data analysis will elucidate if the increased lymphocyte count is due to a significant increase in T naïve cell count.

# Kathia Antillon

**“The MC3 and MC4 Melanocortin Receptors as an Alternative Form of Pain Treatment”**

ABSTRACT: The current study seeks to find alternative and equally potent methods of pain medication in lieu of the traditional opioid medications. The Melanocortin Receptors (MCRs), through a shared amino acid pharmacophore with the opioid receptors, have been identified as an alternative place where these medications can be developed. Of the five different melanocortin receptors present in the system, the MC3R and MC4R have been linked to nociceptive pain and analgesia through various studies (Bellasio et al. 2003). These links to pain treatment provide the basis for the current research study. One of the main agonists at these receptors, Melanotan II (MTII), has selectivity at all of the MCRs but has been shown to be especially potent at the MC3R and MC4R (Starowicz et al. 2005). In order to specialize MTII at the desired receptors, derivatives of MTII containing a slightly changed amino acid sequence will be synthesized using microwave assisted Solid Phase Peptide Synthesis with shaking assisted macro molecule cyclization. Mass Spectrometry, together with HPLC techniques will be applied for identification and purification of the derivative. In vitro binding and cAMP assays will then be used to determine the potency and effectiveness of each derivative.

# Miguel Pena

## "Artificially Engineered Protein for Antimicrobial Material Production"

ABSTRACT: The rise of antimicrobial resistant bacteria has inspired the search for alternative treatments for infection. Antimicrobial peptides (AMP) have shown potential but have an efficacy range known to be toxic to humans and degrade rapidly in the bloodstream (Kumar et al., 2018). Our goal is the development and production of an AMP tethering platform comprised of artificial elastin-like polypeptide (ELP) that can be biosynthesized in Escherichia coli (E. coli) in high yield and non-chromatographically purified using the reversible solubility of ELP below and insolubility above a programmed temperature. The ELP-AMP protein enhances AMP stability in vivo and adding tyrosine residues to ELP {ELP(Tyr)} enables material production through tyrosine photo-crosslinking. The necessary genetic sequence, provided by Ingrole et al. (2014), was introduced into BL21 E. coli cells, and then used to express the protein. The solution was purified using the Inverse Transition Cycling (ITC) method, and a final protein yield of 356 +/- 47mg per liter of expression was obtained. ELP(Tyr) hydrogels were produced using ruthenium mediated photo-crosslinking of tyrosine residues (Fancy and Kodadek, 1999). Mechanical properties of ELP(Tyr) hydrogels were investigated for the translation to potential ELP(Tyr)-AMP material applications.

# Nakayla Griffin

## "Sleep Duration and Objective Cognitive Function: Data from a Nationally-Representative Sample"

ABSTRACT: Habitual sleep duration has been associated with obesity, cardiometabolic disease risk, and decreased cognitive function (Grandner, 2017; Brzecka et al., 2018). Insufficient sleep in particular leads to cognitive impairments such as decreased processing speed and inattention (Goel, 2017). These studies are largely confined to the laboratory, though. The goal of the present analysis is to extend these laboratory findings to a population-level sample.

The combined 2011-2014 National Health and Nutrition Examination Survey (NHANES) was used. Sleep duration was assessed as hours of sleep on a typical night and categorized as very short (≤4h), short (5-6h), normal (7-8h), or long (≥9h). Cognitive function was assessed using the Digit Symbol Substitution Task (DSST), a test of processing speed, and Animal Category Fluency (ACF), a test of verbal functioning. These were administered to a nationally-representative sample of N=2,949 adults. Covariates included age, sex, and education. Regression analyses were weighted using NHANES sample weights.

In adjusted analyses, very short sleep was associated with impaired performance on the DSST (B=-5.15;95%CI[-8.57,-1.72];p=0.003) and ACF (B=-1.45;95%CI[-2.49,-0.40],p=0.007). Short sleep was also associated with impaired DSST (B=-1.87;95%CI[-3.39,-0.35);p=0.016) and ACF (B=-0.56;95%CI[-1.12,-0.0001];p<0.05). Long sleep was also associated with impaired DSST (B=-3.63;95%CI[-5.75,-1.51];p=0.001) and ACF (B=-1.08;95%CI[-1.94,-0.21],p=0.015).

Overall, both short and long sleep duration were associated with worse cognitive performance at the population level. This suggests that cognitive effects of sleep deprivation and excessive sleep are experienced outside of the laboratory and in real-world settings. Future research should examine a broader range of tests and effect modifiers (e.g., are some

# Melissa Martinez

## "Variability of Aging Perceptions Among Older Adults Living in Diverse Settings"

ABSTRACT: Studies in aging and cognition have focused on various characteristics that may influence aging perceptions such as social engagement, health, and cognition and how these factors can promote successful aging. While aging perceptions have recently been studied within these contexts, limited research has focused on the effects of current living situation as it pertains to perceptions of aging. The main focus of this study was to examine perceptions of aging in place between seniors residing in assisted, community and independent living communities. Eighteen healthy older adults (ages 65-92) were recruited from community living on own, independent and assisted living facilities and completed the Attitudes Towards Own Aging (ATOA) subscale of the Philadelphia Geriatric Morale Scale and the Aging Perceptions Questionnaire (APQ). Results indicated that groups significantly differed $F(16)=3.61$, $p<.05$ on the ATOA subscale, however there were no significant differences between groups on the subscales of APQ. Further analyses revealed the groups greatly differed by age and by adding age as a covariate our model was no longer significant, $F(2, 19)= 2.63$, $P=.103$.The results demonstrate that age may greatly affect aging perceptions. While aging perceptions did not demonstrate to be influenced by the current living situation, it guides further research into understanding what other factors influence perceptions of age, in order to better interventions in elder adult care

# Emily Wilson

**“The Role of Chemical Structure in AM2 S31N Inhibitors”**

ABSTRACT: Influenza A is a common respiratory illness that is responsible the hospitalization of 200,000 Americans annually (Lafond et al., 2016). M2 channel inhibitors, however, are not recommended for the treatment of Influenza A due to the increase of strains that are resistant against M2 inhibitors. Mutations within the M2 proton channel are responsible for the resistance, and current efforts are focused on developing M2 inhibitors that are effective against several mutated strains of Influenza. The primary objective of this study is to optimize derivatives of amantadine for broad spectrum effectiveness against Influenza. Compounds are synthesized using amine-coupling chemistry, purified using flash chromatography, and verified using H NMR. Each compound is tested for antiviral activity and channel blockage using plaque assay and two-electrode clamp assay, respectively. Initial results from the study will be presented and discussed.

# Madison Schultz

## "Effect of Acculturation and Inflammation on the Quality of Life of Latina Cancer Survivors"

ABSTRACT: Many cancer survivors face increased mental, physical, and emotional stress in their everyday life, known as survivorship burden. In particular, Latina breast cancer survivors report a lower health-related quality of life when compared to non-Latina White breast cancer survivors. This study will investigate whether levels of acculturation stress and inflammation have an effect on the health-related quality of life experienced by Latina breast cancer survivors. Additionally, the study will investigate the differences in quality of life between Latina and non-Latina White breast cancer survivors. Participants will include 60 Latina and 60 non-Latina White women who have been diagnosed and undergone treatment for breast cancer within the past 5 years. Participants will provide information regarding demographics, socio-cultural factors, and quality of life factors via a phone interview completed both at the start of the study and three months after the study. Additionally, participants will undergo the Trier Social Stress Test, and their blood will be analyzed for inflammatory markers in order to measure levels of inflammation. Data collected will be analyzed for variable relationships through T-tests as well as regressions. We expect Latina breast cancer survivors with higher levels of acculturation stress and inflammation will experience a lower quality of life. The results of the proposed study will hopefully reveal disparities in post-treatment life in Latina breast cancer survivors, which may lead to unique ways to help the Latina community.

# Jesus Mulgado

**“Integration of high resolution land cover data into PC-Hydro’s parameters”**

ABSTRACT: The Rational Formula based PC-Hydro is a model used by Pima County’s Regional Flood Control District to predict peak discharge from runoff. The peak discharge values are used to design and evaluate newly constructed structures to be able to withstand runoff from a 100-year event storm. Currently, PC-Hydro has been running with tabulated values for percent impervious land cover. In order to increase PC-Hydro’s validity, a new imperviousness land cover layer has been created within a geographic information system (GIS). With the newly available land cover layer, percent impervious can now be accurately derived from any watershed and implemented into PC-Hydro’s parameters. The purpose of the present study is to compare the tabular-based method used before the existence of high-resolution land cover with the method utilizing the newly-available land cover data. The hypothesis for this research is that with the newly acquired land cover layer, PC-Hydro's results will have an increased accuracy over the previous method that utilized tabulated values. Using ArcGIS, three watersheds have been delineated and integrated with the new land cover layer. PC-Hydro was then run with the percent land impervious data taken from ArcGIS. PC-Hydro’s results using the land cover layer and the table method were compared with a flood frequency analysis. Results showed an increase in peak discharge runoff where the layer was applicable. However, more analysis is needed to determine the amount of impact the new land cover-based layer provides.

# Keturah Ragland

## "Multisensory Integration Occurs Within the Primate Amygdala"

ABSTRACT: The use of non-human primates in neuroscientific research has allowed for great advances in the understanding of social behavior and social perception in humans. Spotlight has been placed on the amygdala during social interactions as it is the social/emotional regulator of the brain and plays a very significant role in emotional learning in both monkeys and humans. Recently, conversation of how multisensory integration affects amygdala processing arose as it showcases how the brain synthesizes external information from a variety of sensory inputs and provides great insight to one's perception. Previous research has examined multisensory integration in the neocortex, however research is sparse in evaluating this process in the amygdala. The current research aims to understand how multisensory integration occurs within the amygdala and how this contributes to perception and social behaviors. To understand these processes, social/non-social stimuli of different sensory modalities were presented to rhesus monkeys and electrodes were used to record activity of single amygdala neurons. Given the nature of the amygdala and its neurons' ability to respond to more than one modality, it is believed that the presentation of audio/visual combined will produce a different response than that of the single modalities and the social nature will impact the integration relationship. Commencing in the spring of this year and spanning throughout the year, this project has begun gathering preliminary data to understand the patterns of multisensory integration in the amygdala and start further analysis in uncovering the significance of multisensory integration in the human amygdala.

# Fernando Paredes

## "Examining the effects of educating elementary school-aged children about self-esteem, emotional regulation, healthy relationship knowledge, and domestic violence"

ABSTRACT: This study identifies best practice for supporting and educating children impacted by domestic violence. Additionally, the prevention of domestic violence and the long- term effects of such educational efforts are examined. According to the Governor's Office of Arizona, a child is exposed to domestic violence every 44 minutes, and this has negative ramifications. Literature has revealed that children exposed to domestic violence experience lowered self-esteem, diminished achievement in school, behavioral issues, emotional regulation issues, and feelings of guilt. Empirical research also indicates that early exposure to domestic violence is a risk factor for victimization or perpetration of domestic violence in adulthood. Educational curriculums geared towards children has demonstrated promising results, however little is known about the long-term impact of such educational programs. It is paramount that we support and educate children exposed to domestic violence. Using systematic literature reviews on previous school interventions and the consultation of non-profit organizations in Arizona, an interactive curriculum geared towards children will be implemented. Utilizing a randomized design and a longitudinal approach, we hypothesize that exposure to domestic violence education as a child will lower rates of victimization and perpetration of domestic violence in adulthood. We also hypothesize that this educational curriculum will serve as a buffer against self-esteem, achievement, and behavioral issues additionally, we hope to foster healthy relationship attitudes at an early age.

# Elizabeth Ogunbunmi

## "Effects of IGF-1 and IGFBP-2 on Beta-cell Proliferation in Control and IUGR Ovine Islets"

ABSTRACT: An intrauterine growth restricted fetus refers to a fetus that has failed to reach its genetic growth potential, due to maternal obesity, diabetes, hypertension, or other factors that affect the intrauterine environment (Barry & Anthony, 2008). The intrauterine environment is sensitive to changes caused by the environment that negatively impact the fetus's growth rate, and organ development. One characteristic of type 2 diabetes is decreased insulin secretion, which is reflective of beta-cell dysfunction. Insulin-like growth factor-1 (IGF-1) is crucial for beta-cell proliferation and is associated with elevated beta-cell mitosis. Insulin-like growth factor binding proteins (IGFBPs) regulate IGFs via transport and distribution (Duan & Xu, 2005). In IUGR fetuses, decreased IGF-1 and increased IGFBP-2 have been observed (Chen, Rozanxe, Hay Jr., & Limesand, 2012). The purpose of the present study is to better understand how IGF-1 and IGFBP-2 affect the activation of insulin signaling pathways in utero using ovine models (IUGR and control models). Control and IUGR islets were cultured respectively in: control media, IGF-1, IGFBP-2, IGF-1+ IGFBP-2, and T3. After culture the islets were prepared for histology fixation and staining. Insulin-positive cells were immunostained with guinea pig anti-porcine insulin polyclonal antibody and nuclei were stained with DAPI. Cellular proliferation was measured by treating islets with EdU. Fluorescent images taken with Leica DM5500 at 20x and digitally captured with an ORCA-Flash4.0 LT Digital CMOS Camera C11440. The present study will attempt to clarify the interaction between IGF-1 and IGFBP-2 in control and IUGR fetuses. Previous research provides compelling evidence that the addition of IGF-1 will increase beta-cell proliferation and the interactions between IGF-1 and IGFBP-2 will decrease proliferation. It is important to consider factors that influence proliferation that can provide insight into the pathophysiology of type 2 diabetes. Modern day treatments place more emphasis on managing diabetes

# Emily Leptich

**“Epigenetic Modulation as a Possible Treatment for Tinnitus ”**

ABSTRACT: Tinnitus is an auditory phantom perception where ringing in the ears occurs in absence of auditory stimuli. It commonly results from hearing loss and is marked by the cortical downregulation of inhibition along with reorganization of tonotopic maps in A1 of the auditory cortex, post auditory pathway damage. The resulting imbalance between excitation and inhibition in the cortex leads to increased excitation serving as hypothetical cause of these phantom perceptions. Recent reports indicate that DNA methylation modulates excitatory and inhibitory synapses and alters the balance between excitation and inhibition. Thus, the question we seek to answer is whether DNA demethylation concomitant with environmental enrichment is sufficient to ameliorate the effects of tinnitus. In this investigation, mice undergo noise-induced hearing loss to induce tinnitus followed by the injection of DNA methyltransferase inhibitors with simultaneous exposure to an enriched environment. Gap Detection and Pre-Pulse Inhibition behavioral testing along with Auditory Brainstem Response testing are utilized at each stage to assess the presence of tinnitus and overall auditory damage extent. The projected timeline of completion is December, 2018.

Ashley Aubrey

THE UNIVERSITY OF ARIZONA

# "The Potential of Yoga as a Health Benefit for Latinx Pediatric Populations: Examining Changes in the Physiological and Psychological Responses to Stress "

ABSTRACT: The present study reviews the link between the social and physiological aspects of toxic stress and provides evidence that these factors effect mental health, primarily, depression. The proposed hypothesis questions that these biosocial stressors can be intervened upon through the practice of yoga and that yoga has positive implications for Latinx populations. Past literature provides evidence that stress and depression have negative consequences on health, to which more specifically, examine how they impact the innate immune response through the changes in specific inflammatory markers (Engert et al., 2018; Radek, 2010) such as c-reactive proteins (McDade, Lindau & Wroblewski, 2011; Engert et al., 2018; Gu, Tang & Yang, 2012), and interlukin-10 (IL-10) (Radek, 2010) as these are the most closely related bio-markers. As a method to reducing stress; other studies examine yoga and its positive effects on the body (Rao et al., 2017), but there is a gap in its work with pediatric Latinx populations and its implications for mental health in minority populations. Information on this study is gathered and evaluated through systematic review from past peer-reviewed database data following the PRISMA-P protocol. Plans for the completion of this study include the continuation of the full systematic review process until the anticipated collection end date and may further be taken through a meta-analysis.

# Devin Cameron

## "Using General Relativistic Magnetohydrodynamic Simulations to Probe the Parameter Space of Sgr A*"

ABSTRACT: Using Very Long Baseline Interferometry (VLBI) the Event Horizon Telescope (EHT) will obtain horizon-scale resolution for Sgr A*. EHT will observe the innermost environment of the accretion flow onto this black hole. The dynamics that describe accretion flows are very complex and unstable, requiring numerical methods to solve. Therefore, we use General Relativistic Magnetohydrodynamic (GRMHD) models to predict what EHT could see. Recent progress in GRMHD simulations of black hole accretion flows has significantly increased our understanding of black hole physics (Narayan, Sądowski, Penna, & Kulkarni, 2012). A limitation of all current simulations is that they fail to represent the thermodynamics of electrons in the low-density plasma. This limitation provides a great challenge in accurately predicting accretion flow images from first principles (Chan, Psaltis, Özel, Narayan, & Sadowski, 2015). To combat this limitation, simplified emission models have been constructed with a range of configurations that are able to match observations of accreting black holes. Investigating the large parameter space of black holes requires significant computational power that ordinary computational facilities cannot provide. We, therefore, employ a general relativistic ray-tracing algorithm, GRay, that uses graphics processing units to quickly integrate millions on photons efficiently, to construct a suite of General Relativistic Magnetohydrodynamic Simulations for many parameters (Chan, Psaltis, & Özel, 2013). Then using Principal Component Analysis (PCA) techniques to investigate the optimal number of eigenimages to characterize the complete space of variability in the simulations and identify outlier events.

# Alex Erwin

**“TITLE”**

ABSTRACT: Medication adherence, which is defined as taking a prescribed medication on-time and as directed, is currently a significant topic in health care. This issue has great significance due to the exorbitant costs, which total between 100 and 300 billion USD yearly, that triage and emergency services patients receive due to underlying condition manifestations exacerbated by the patient’s, and possibly their families’, lack of adherence to prescribed medication treatment protocol. Will including patients as stakeholders in an iteratively developed and collaboratively patient sourced smartphone-based medication adherence application increase their own medication adherence outcomes? The purpose of this study is to determine if increasing the role of the patient in the development process of a smartphone-based adherence tool will enhance their medication adherence rates due to the patient’s perceived elevation of stature, expended collaborative effort, and the resulting evocation of a sense of accomplishment. The study solicited the patients’ perceptions, observations, and feedback on their low adherence susceptibility, comfort and usefulness perceptions of a smartphone’s potential as a health care tool, and the required versus desired application functionality. Surveys, personal interviews, a focus group, and an iteratively developed adherence tool were utilized. The study is expected to conclude mid to late August. Preliminary data reveals that patients strongly perceive using a smartphone as an adherence tool is of great importance and prefer the tool to be aggressively persistent in reminding them to take their medications.

# Czarina C. Retana

**“Assessing S100A7 and miR-21 Regulation in Oral Squamous Cell Carcinoma”**


ABSTRACT: Background

Oral Squamous cell carcinoma (OSCC) accounts for 95% of all oral carcinomas in head and neck squamous cell carcinomas (HNSCC). The survival rate of OSCC patients is 5 years. Inability of early detection at time of diagnosis indicates the lack of biomarkers. Immunohistochemical studies in HNSCC patients showed high S100A7 expression levels associated with poor prognosis indicating the need to investigate S100A7 molecular mechanism of regulation in OSCC. Since microRNA(miR)-21 is known to play a role in cancer progression, the goal of this project is to determine the regulation of S100A7 and miR-21 in OSCC.

Methods

To identify molecules interacting with S100A7 immunoprecipitation (IP) of S100A7 complexes were isolated from whole cell-lysis extracts. Expression of S100A7 was performed by immunofluorescence, and of miR-21 and AKT-pSer473 by combined fluorescence in situ hybridization (FISH) and immunofluorescence. S100A7 knock-down was performed by lentiviral siRNA/S100A7 transduction in SCC-9 cells, and expression levels of S100A7 and miR-21 was analyzed by qRT-PCR.

Results

SCC-9 cells express high levels of S100A7, AKT-pSer473 and miR-21. IP studies showed that S100A7 does not interact with the known S100 ligand-receptor, RAGE, but with other non-identified molecules. QRT-PCR analysis show that S100A7 knock-down decreases expression of miR-21 and increases miR-21 target, PTEN.

Conclusion

These data show that S100A7 regulates miR-21 and that activated AKT regulates S100A7 in OSCC.

# Dallas Altamirano

**"Thermal and Mechanical Reinforcement of Injectable Protein-Based Hydrogels Through Ligand Mediation for Long-term *in vivo* Applications "**

ABSTRACT: Here, we report investigations on the effects of ligands on the thermal and mechanical stability of physical bonds within protein-based hydrogels. Specifically, we studied the stabilizing effects of biotin, a coenzyme native to the body, on streptavidin, a self-oligomerizing protein with strong monomer-monomer interactions and relatively weak dimer-dimer interfaces. With the addition of biotin, the dimer-dimer rupture force of streptavidin tetramers increased by approximately 200% using atomic force microscopy (AFM)-based single molecule force microscopy (SMFS). Subsequently, we developed hydrogels consisting of telechelic proteins with streptavidin monomer end groups using genetic engineering techniques and synthesized them using recombinant protein expression. Streptavidin-crosslinked hydrogels were characterized using rheology and bioerosion tests, presenting a potential design model in which physical biomaterial networks can be fabricated with ligand-mediated improvements to its mechanical and thermal stability. Our findings indicate a decreased erosion rate of streptavidin-crosslinked hydrogels compared to a control protein-based hydrogel, permitting long-term in vivo capabilities. Thus, we identify a novel class of protein-based physical hydrogels with injectability, high strength, and biotin-mediated stability for potential applications in minimally invasive tissue engineering and regenerative medicine such as cartilage replacement, drug delivery, and wound healing.

# Christina Loera

**“Determining Hepatotoxicity with Organ on a Chip (OOC) Technology”**

ABSTRACT: Herbal medicine, a burgeoning health trend in Western medicine, has touted a variety of health benefits, such as weight loss and immune support. Due to limited regulatory oversight, many supplements that are readily available to consumers can cause dangerous side effects such as liver failure (hepatotoxicity). Therefore, it is of grave importance to clinically test the effects of herbal medicine on liver function. To address this challenge, research has been directed toward Organ on a Chip (OOC) technology, a 3-D cellular microenvironment that mimics an entire human organ by emulating flow conditions, and operates on a time scale of roughly 28 days (No et al., 2015; Prodanov et al., 2016). This study is pursuing a two-pronged approach, both aiming to address issues with OOC technology while continuing research into hepatotoxicity related to herbal medicine. Our goal is to design an efficient microfluidic chip that can model both acute and chronic toxicity in a human liver. By changing certain variables such as the geometry of the flow channels of the microfluidic chip, and by creating an apparatus that mimics the nutrient flow of a human liver, this study aims to recreate a testing environment that can predict potential cell toxicity. Upon estimated completion in December, this study’s apparatus can be utilized to dramatically decrease the time needed to test for hepatotoxicity. Eventually the apparatus can be utilized in personalized medicine to determine safe dosages of medication for individual patients.