# C.A.R.E.S SYMPOSIUM

**C**areer **A**cademic and **R**esearch **E**xperience for **S**tudents

## 2020
*Virtual Edition*

**JULY 30**
**10:00 AM - 2:00 PM**

JOHNS HOPKINS
UNIVERSITY

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# C.A.R.E.S Symposium Objectives

1. Showcase Summer Programs that provide paid internships in Hopkins laboratories, clinics, and offices across the medical campus for nearly 300 students with more than half from Baltimore City high schools.

2. Provide opportunities for 200 selected students to deliver a professional presentation to an audience of 350 attendees, including Hopkins faculty, faculty and recruits from local colleges and universities, and each other.

3. Bolster high school students' academic and social confidence by enabling them to compete and compare the quality of their academic presentations to high achieving undergraduates from all over the United States.

4. Inspire a generation of future leaders by providing a stage for students and keynote speakers of international prominence to share their journey, struggles,and lessons learned in achieving their dreams.

5. Invest in untapped local talent to generate a homegrown workforce with a college degree and improve the odds of success among aspiring leaders to pursue a career in science, public health, or medicine.
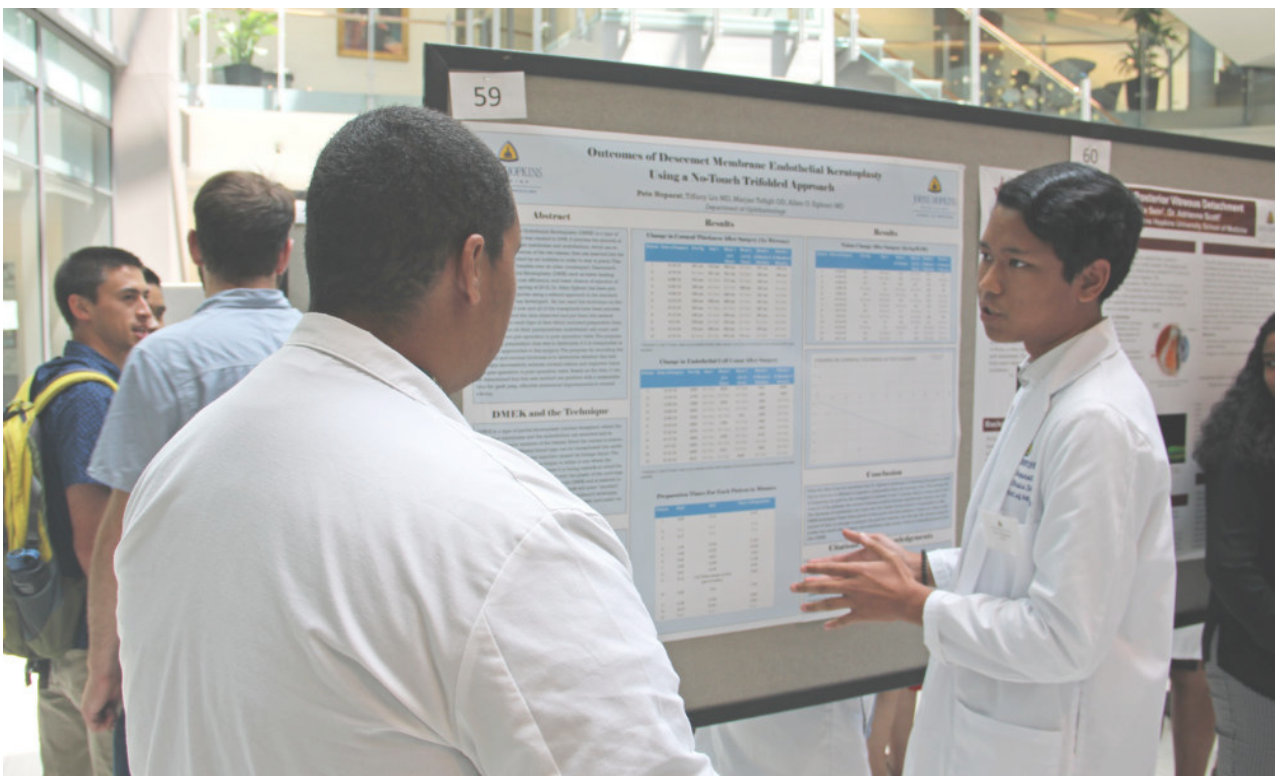
# Program Descriptions

**Basic Science Institute Summer Internship Program (BSI SIP)**
BSI SIP provides experience in research laboratories to students of diverse backgrounds, including underrepresented minority students, students from economically disadvantaged and underserved backgrounds and students with disabilities that have completed one - two or more years of college. The purpose of this exposure to biomedical and/or public health research is to encourage students to consider careers in science, medicine and public health.

**Biophysics Research for Baltimore Teens (BRBT)**
BRBT gives Baltimore city teens a chance to do basic biomedical research in Johns Hopkins biophysics labs on both the Homewood and JHMI campuses. BRBT is offered through the Johns Hopkins Program in Molecular Biophysics (PMB), and PMB graduate students on both campuses mentor BRBT interns. The interns' exposure to laboratory research is augmented with a weekly course in basic laboratory skills taught by graduate students and overseen by PMB faculty.

**Bloomberg Distinguished Professor Summer Training And Research Program (BDP STAR)**
BDP STAR offers interested undergraduates the opportunity to partner with participating Bloomberg Distinguished Professors over the summer. The BDP faculty and affiliated labs and centers provide the research projects, training and guidance.

**CTY Student Summer Research Program (CTY): Sponsored by the Simons Foundation**
CTY Student Summer Research Program invites high achieving, academically advanced high school students to participate in residential research experiences across disciplines at both the Johns Hopkins University and School of Medicine. This six-week residential program pairs students with research mentors through a highly selective process, which considers both student and mentor skills and interests. Students attend career and research seminars and participate in a journal club sponsored by each host lab.

**Centro SOL Programa de Verano para Jóvenes (Centro SOL)**
Centro SOL Summer Scholars is a summer program for Spanish/English bilingual high school students in Baltimore City. The program's goal is to expose bilingual high school students to the medical field by offering meaningful opportunities to work with JHU School of Medicine faculty in clinical settings that serve Latino patients with limited English proficiency. In addition, students shadow Johns Hopkins Hospital Spanish language interpreters. This experience allows them to appreciate the importance of professional medical interpretation during clinical encounters and gives them an opportunity to pursue further training in this area if they are interested. Students who are fluent in both Spanish and English are invited to apply to the program. Through this program, we expose motivated Baltimore youth to careers in medicine, mentor them at a leading medical institution, and empower them to pursue further training that capitalizes on their Spanish language skills, while improving services to our Latino patients.

**Diversity and Academic Advancement Summer Institute (DAASI)**
DAASI is a partnership between Johns Hopkins School of Medicine's Office of Student Pipeline Programs and Thread (formerly Incentive Mentoring Program). The goals are three-fold: (1) Academic Assistance: Provide a comprehensive, engaging curriculum to bolster participants' academic self-confidence and capabilities; (2) Service, Life Skills, and Team Work: Create opportunities for participants to learn important life and professional skills through work opportunities and service learning experiences; and (3) Visualizing Success: Expose them to science and health educational pathways so that they may visualize the possibility of pursuing careers in science.

**The Foundation for Advanced Research in the Medical Services (FARMS)**
FARMS offers opportunities in the Institute for Cell Engineering (ICE) in one of our four program areas: Vascular Biology, Stem Cell Biology, Immunology or Neuroregeneration. Program participants may participate in a broad array of projects from computational biology, gene regulatory networks,immune system development, lymphoid malignancies, molecular and cellular mechanisms of oxygen regulation, molecular and cellular signals controlling neurodegeneration, neurogenesis, single cell biology, stem cell modeling, gene and stem cell therapies, MRI cell tracking techniques, or stem cell engineering. The rich environment and guidance by our faculty helps prepare students for successful careers as independent research scientists. Interns are expected to participate in all student related activities in ICE, conduct research and write a small progress report at the end of their internship or present their work in a poster session at the end of the summer.

**Health Career Opportunities Program (HCOP)**
The Health Careers Opportunity Program summer internship provides experience in research laboratories to students from economically or educationally disadvantaged backgrounds that have completed one - two or more years of college. The purpose of this exposure to biomedical and public health research is to encourage students to consider careers in the health care workforce. Students in the HCOP division work in labs in both the School of Medicine and the Bloomberg School of Public Health.

**Institute for Computational Medicine (ICM)**
ICM provides extended research experiences for undergraduates who are interested in the development of quantitative approaches for understanding the mechanisms, diagnosis and treatment of human disease through applications of mathematics,engineering and computational science. An internship at the ICM provides a significant research opportunity that can lead to authored publications, presentations at conferences, and a competitive advantage for students who pursue graduate programs and professional research-based careers.

**Institute for NanoBioTechnology Research Experience for Undergraduates (INBT)**
The Institute for NanoBioTechnology at Johns Hopkins University offers undergraduate students from colleges and universities around the country a chance to participate in research projects in the exciting and rapidly growing area of nanobiotechnology, a place where biology, medicine, and nanoscience meet. For more information, visit http://inbt.jhu.edu/education/undergraduate/nanobio-reu/.

**Kennedy Krieger
Institute Maternal Child Health-Leadership Education, Advocacy, and Research Network (MCHLEARN)**
MCH-LEARN is a nine-week summer and academic year maternal child health (MCH) program that provides integrated public health, clinical and research learning experiences. MCHLEARN is designed for college freshmen, sophomores and juniors in the Baltimore and Washington, D.C., areas who are interested in MCH professions (pediatric medicine, nutrition, social work, nursing, pediatric dentistry, psychology, health education, occupational/physical therapy, speech-language pathology, public health). Students from underrepresented and/or disadvantaged populations are strongly encouraged to apply. Students must have an overall grade point average of at least 3.0 on a 4.0 scale. The program provides scholars with mentorship using interdisciplinary training experiences, leadership and professional development, and didactics focusing on promoting health equity within MCH populations. The ultimate goal of MCH-LEARN is to support diverse students' academic success to professional careers in MCH disciplines.

**Maternal Child Health Careers/Research Initiatives for Student Enhancement Undergraduate Program (MCHC/RISE-UP)**
MCHC/RISE-UP is a 9-week summer program designed for undergraduate juniors and seniors and recent baccalaureate degree students (within 12 months of the MCHC/RISE-UP program orientation), with a grade point average of at least 2.7 on a 4-point scale who are interested in learning more about public health and preventing health disparities. MCHC/RISE-UP is a national consortium of institutions including the Kennedy Krieger Institute, Maryland Center for Developmental Disabilities, Johns Hopkins University School of Medicine, Nursing, and Public Health, University of California- Davis, and the University of South Dakota Sanford School of Medicine Center for Disabilities and Tribal Serving Institutions. MCHC/RISE-UP offers public health leadership learning experiences in clinical, research, and community engagement and advocacy areas. All scholars interested in addressing health disparities are eligible to apply.

**National Institute of Diabetes and Digestive and Kidney Short-Term Research Experience for Underrepresented Persons (NIDDK STEP-UP)**
NIDDK STEP-UP provides hands-on summer research experience for high school and undergraduate students interested in exploring research careers. The overall goal of the program is to build and sustain a biomedical, behavioral, clinical and social science research pipeline focused on NIDDK's core mission areas of diabetes, endocrinology and metabolic diseases; digestive diseases and nutrition; and kidney, urologic and hematologic diseases.

**Medical Education Research Initiative for Teens (MERIT) Health Leadership Academy**
The MERIT Health Leadership Academy is a nonprofit academic and career mentorship program supporting Baltimore City high school students who aspire to careers in medicine. MERIT scholars take advanced academic classes on Saturdays; work in hospitals, labs, and community organizations during paid internships; and receive long-term college and career mentorship. This summer, scholars shadowed professionals in clinical and laboratory settings across the city. As rising juniors, MERIT scholars participate in clinical internships, giving them the opportunity to experience health care in the real world. MERIT scholars shadow up to 20 different health care providers in a variety of settings including intensive care, pediatrics, outpatient clinics, surgery, and more. As rising seniors, scholars conduct independent research based on their interests under the guidance of a mentor. Scholars participate directly in the research process, engaging in projects that drive scientific discovery and medical advancement.

**Pulmonary and Critical Care Medicine Summer Internship Program (PCCM)**
The Division of Pulmonary and Critical Care Medicine hosts undergraduate students each summer as part of an NIH-funded program to enhance diversity in biomedical sciences. Students from around the United States and Puerto Rico join faculty for a ten-week, research-focused experience that extends from Memorial Day weekend through the first week of August. Students are matched with mentors based on their interests. Students work on specific research projects under the supervision of their mentor. Projects span a broad range of research, from the basic science of endothelial or epithelial cell biology to asthma epidemiology. In addition to the research experience, students participate in a weekly journal club, during which they present primary research articles to their peers and members of the faculty. Students also attend a seminar series featuring faculty members from Johns Hopkins and the NIH. This forum provides students with the opportunity to interact with faculty members and hear different perspectives on issues related to career development. Students interested in clinical medicine are given the opportunity to "round" with the Johns Hopkins Medicine residents, providing a glimpse of life in clinical medicine as a resident at an academic institution.

**Summer Academic Research Experience (SARE)**
SARE is an 8-week outreach program that seeks to develop exceptional high school students from the greater Baltimore area by introducing them to academic research with a secondary emphasis on STEM and health-related professions. We provide our scholars with a unique exposure to modern scientific research, combined with academic fortification to enhance science, writing, and mathematics skills.  Throughout the summer, students work closely with experienced mentors who support the student as they experience the world of scientific inquiry and develop their own research.

**Summer Training And Research (STAR) Program**
STAR operates as the summer cycle for the ongoing PURA program and is open to all JHU undergraduate students. The program offers JHU undergraduate students the opportunity to stay in Baltimore during the summer to start or continue a research, creative, or scholarly project with a Hopkins faculty member or lab in any division, department, or program related to Johns Hopkins.

**The Johns Hopkins Neuroscience Scholars Program (JHNSP)**
The Johns Hopkins Neuroscience Scholars Program (JHNSP) is a multi-year, national program dedicated to mentoring underrepresented minority (URM) and deaf or hard-of-hearing (D/HH) undergraduates. It provides students in-depth exposure to the neuroscience field. Beginning in the summer, participants will attend professional development workshops, perform 10 weeks of intensive research, and network with other students. Throughout the academic year, scholars receive individualized advising in their paths to graduate or medical school.

**Johns Hopkins NeuroHIV-Comobidities (Neurophytes) Scholars Program**
This program aims to significantly increase the  motivation  and  persistence  of  undergraduates  who  reside  in areas  in  the  USA  where  the  incidence/prevalence  of  HIV/AIDS  remain  high  to  pursue  graduate  training  toward a  research  career  focused  on  the  complications  of  HIV  infection  of  the  central  nervous  system  (NeuroHIV)  and its  associated  comorbidities.

Our mission is to expose highly motivated undergraduates, particularly those that reside in high HIV-1 incidence/prevalence regions, to an education-research mentoring institute focused on NeuroHIV and its associated comorbidities in order to serve those urban and rural communities most affected by the diseases.

# SCHEDULE OF EVENTS

| TIME | SESSION | SPEAKER |
|---|---|---|
| 10:00 AM – 10:10 AM | Welcome | Damani Piggott, MD, PhD, MS, MPhil |
| 10:10 AM – 10:40 AM | Keynote Speaker | Sherita Golden, MD, MHS |
| 10:40 AM – 11:15 AM | Student Stories | Charlene Mansour, PCCM<br>Leslie Fuentes, Centro SOL<br>Lidiya Muche, BRBT<br>Denzel Edwards, PCCM<br>Erick Baires-Zavala, Centro SOL<br>Noor Ul Ain, SARE |
| 11:15 AM – 12:15 PM | Oral Presentations | Alexandra Wong, JHNSP<br>Amanda Barreto, BSI<br>Edian Cuevas, JHNSP<br>Hana-Joy Hanks, BSI<br>Jacqueline Amaya, Centro SOL<br>Jacqueline Liu, MCH-LEARN<br>Jasmin Thames, MCH-LEARN<br>Kelly Sibrian, Centro SOL |
| **INTERMISSION** | | |
| 12:20 PM-1:20 PM | Oral Presentations | Kristiana Smith, SARE<br>Madison Williams, MCH-LEARN<br>Mariama Morray, MCH-LEARN<br>Matthew Hailemariam, MCH-LEARN<br>Naomi Johnson, BSI<br>Nina Bryan, MCH-LEARN<br>Shantika Bhat, SARE<br>Vivian Flanagan, MCH-LEARN |
| 1:20 PM-1:30 PM | Scholarship Award Presentation | Amanda Brown, PhD |
| 1:30 PM – 1:35 PM | Closing Remarks | Damani Piggott, MD, PhD, MS, MPhil |

**Damani A. Piggott, MD, PhD, MS, MPhil**
Assistant Dean for Graduate Biomedical Education and Graduate Student Diversity
Assistant Professor of Medicine and Epidemiology
Co-director, Hopkins Post-baccalaureate Research Education Program
Johns Hopkins University School of Medicine
Johns Hopkins University Bloomberg School of Public Health
Co-director, James A. Ferguson Emerging Infectious Diseases Fellowship program
Kennedy Krieger Institute



Dr. Piggott is Assistant Dean for Graduate Biomedical Education and Graduate Student Diversity and Assistant Professor of Medicine and Epidemiology at Johns Hopkins University. Dr. Piggott received his B.S. degree in Biology and Spanish from Morehouse College. He subsequently attained his M.D. and Ph.D. in Immunology from Yale. He received board certification in Internal Medicine, Pediatrics and Infectious Diseases, having completed residency training at Yale and fellowship training in Infectious Diseases and Epidemiology at Johns Hopkins. Dr. Piggott has worked on clinical and research projects in urban and rural communities in the United States, the Caribbean, Mali and South Africa. He is actively engaged in the clinical care of patients with HIV and his current research program centers on understanding the biological, behavioral, and social pathways necessary to improve survival and quality of life for persons aging with HIV, particularly for socially marginalized, historically disadvantaged, and resource-constrained HIV-infected communities.

**Sherita Hill Golden, MD, MHS**
Hugh P. McCormick
Family Professor of Endocrinology and Metabolism and Vice President and Chief
Diversity Officer for Johns Hopkins Medicine



Dr. Sherita Hill Golden is the Hugh P. McCormick Family Professor of Endocrinology and Metabolism and Vice President and Chief Diversity Officer for Johns Hopkins Medicine. She holds joint appointments in the Welch Center for Prevention, Epidemiology, and Clinical Research, in the Department of Epidemiology at the Johns Hopkins Bloomberg School of Public Health, and in the Armstrong Institute for Patient Safety and Quality. She served as Director of the Johns Hopkins Hospital Inpatient Glucose Management Program from 2003-2018 and as Executive Vice-Chair of the Department of Medicine from 2015-2019. Dr. Golden graduated Phi Beta Kappa and summa cum laude from the University of Maryland, College Park and Alpha Omega Alpha from the University of Virginia School of Medicine before training in Internal Medicine and Endocrinology, Diabetes, and Metabolism at the Johns Hopkins Hospital. During her endocrinology fellowship she received a Master of Health Science degree in Clinical Epidemiology from the Johns Hopkins University Bloomberg School of Public Health where she was elected to the Delta Omega Public Health Honorary Society.

## Sherita Hill Golden, MD, MHS

Hugh P. McCormick
Family Professor of Endocrinology and Metabolism and Vice President and Chief
Diversity Officer for Johns Hopkins Medicine

The author of more than 180 articles, Dr. Golden's epidemiological research interests focus on two areas: (1) endogenous sex hormones as risk factors for CVD, type 2 diabetes, and insulin resistance in post-menopausal women and (2) mental health complications of diabetes and the biological, hormonal, and behavioral factors that might explain these associations. Her health services research focuses on understanding and eliminating diabetes health disparities and implementing and evaluating systems interventions to improve patient safety and quality of care in hospitalized patients with diabetes. She serves as the Principal Investigator of the Johns Hopkins site of the Diabetes Prevention Program Outcome Study and is an elected member of the American Society for Clinical Investigation and the Association of American Physicians. In 2017, she was the co-recipient of the Walter Reed Distinguished Achievement Award from the University of Virginia School of Medicine, Medical Alumni Association, and Medical School Foundation, which recognizes professional accomplishment, outstanding innovation, and exemplary leadership in the field of Medicine. In 2018, Dr. Golden was named a winner of the 17th Annual Women Worth Watching Awards from the Profiles in Diversity Journal. She was one of 132 winners from across the globe recognized as an executive leading the way to excellence in the workplace, marketplace and the world. Dr. Golden is also the recipient of the 2019 University of Virginia Distinguished Alumna Award. She is a devoted mentor and served as Director of the Epidemiology and Clinical Research in Diabetes and Endocrinology Training Grant from 2010-2019. She is a member of the American Diabetes Association National Board of Directors.

# Background Stories

*Students participating in a summer program are given the opportunity to share their personal story of adversity, lessons learned, and how it has molded them into who they are today.*
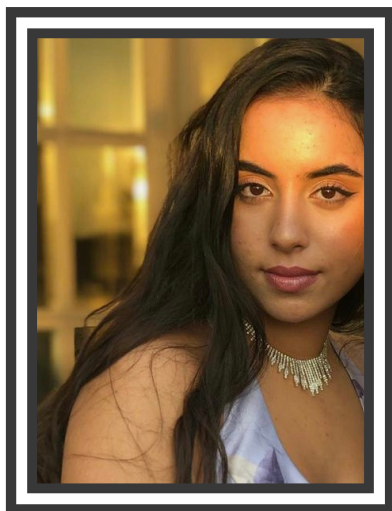
## Charlene Mansour

"Difficult roads often lead to beautiful destinations."

Program: Pulmonary and Critical Care Medicine Summer Internship Program

Current School: The University of Alabama at Birmingham

Future Goals: My professional goal is to become a physician-scientist who improves outcomes for underserved populations in this nation through clinical practice and research, as well as in developing countries through medical mission work.

## Leslie Fuentes

*"Happiness is not by chance, but by choice"*
Jim Rohn

Program: Centro SOL

Current School: Baltimore City College

Future goals: I want to become a pediatrician.

## Lidiya Muche

*"The religious and cultural barriers I faced are my motivation to helping communities like my own understand the realities of mental illness and the importance of mental health."*

Program: SARE and Biophysics Research for Baltimore Teens (BRBT)

Current School: Baltimore City College High School

Future Goals: My educational goal is to double major psychology and education in college on a pre-med track, and later on either go to graduate school to become a psychologist or medical school to become a psychiatrist.

## Denzel Edwards

"*Let us remember that, as much has been given us, much will be expected from us, and that true homage comes from the heart as well as from the lips and shows itself in deeds*"
Theodore Roosevelt

Program: Pulmonary and Critical Care Medicine Internship (PCCM)

Current School: Dominican College of Blauvelt, NY

Future Goals: My dream is to become a traveling physician-scientist who provides care to the less fortunate, advocates medicine as a public trust, and extend acquired knowledge to unfavorable communities.

## Erick Baires- Zavala

*"Never give up, keep going"*

Program: Centro SOL

Current School: Baltimore City College

Future goals: My future goals in life are to finish college and own a business.

## Noor Ul Ain

*"Change your thoughts and you change your world."*
Norman Vincent Peale

Program: Summer Academic Research Experience (SARE)
Current School: University of Maryland College Park

Future goals: I want to pursue a career in medicine, but I am not sure for now if I want to pursue a PhD or MD. I also want to work to improve medical practices around the world especially in developing countries throughout my career. For now I am going to pursue pre med track in UMD.
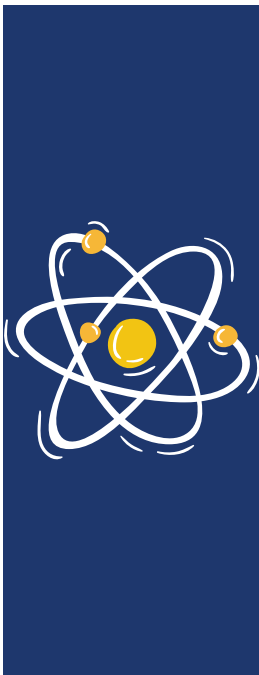
# RESEARCH ABSTRACTS
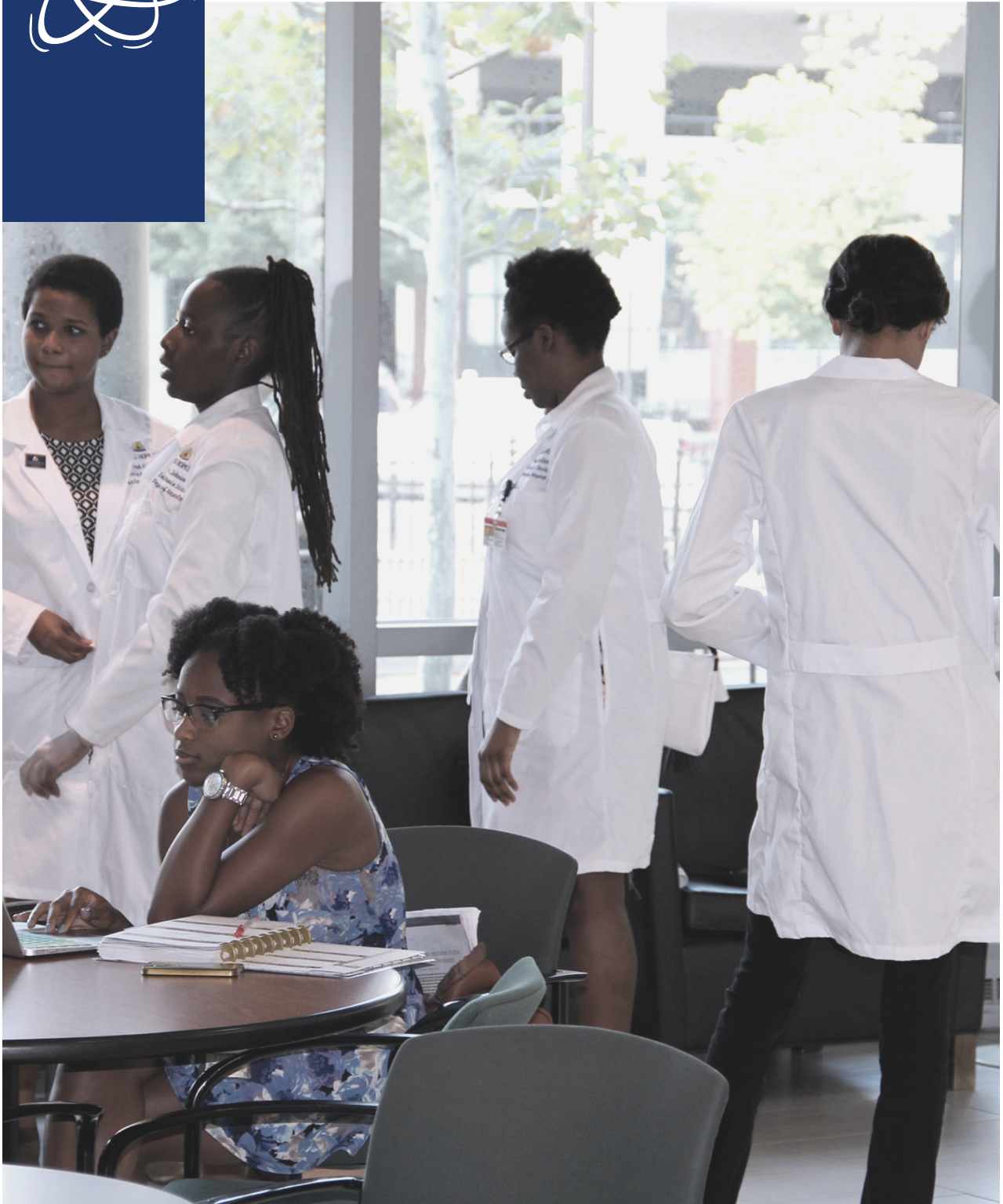
# THE JOHNS HOPKINS INTERNSHIP IN BRAIN SCIENCES (JHIBS) PROGRAM

# BERENICE ALMAGUER

## Examining the Relationship Between Wnt Signaling and Neurodegeneration in C9orf72-ALS

Amyotrophic lateral sclerosis (ALS) is a prototypical neurodegenerative disease that is characterized by the progressive degeneration of motor neuron in the brain and spinal cord. The GGGGCC ($G_4C_2$) hexanucleotide repeat expansion (HRE) in the C9orf72 gene has been identified as the most common genetic cause of ALS. Three known pathogenic mechanisms are hypothesized to explain how this repeat expansion causes the disease: (1) C9orf72 haploinsufficiency as the HRE interferes with transcription or translation of the genes, causing decreased production of C9orf72 protein. (2) Gain-of-function toxicity due to RNA foci formed by sense and antisense transcripts containing HRE which may interact with and sequester essential RNA binding proteins, causing neurotoxicity. (3) Repeat associated non-AUG (RAN) translation of expanded sense $G_4$ $C_2$ and antisense CCCCGG ($C_4G_2$) repeats produces potentially toxic dipeptide repeat proteins (DPR). Wnt signaling is involved in neurodegenerative processes but little is known about the role of Wnt signaling during ALS progression and how this may change over time. Even less is known regarding the role of Wnt in C9orf72-mediated ALS, and our lab is specifically interested in this topic. We hypothesize that the upregulation of Wnt signaling leads to aberrant cell cycle re-entry and that this leads to neurodegeneration due to the disruption of the nuclear pore. To assess this hypothesis, I will critically analyze our lab's work in the context of current literature to determine whether the currently available data supports or contradicts the hypothesis. I will also propose additional experiments that may help further address this question.

# CATALINA ARGANDONA

## HIV-1 Tat protein primes NLRP3 Inflammasome by upregulating NLRP3expression via NF- κ B activation

HIV-associated neurocognitive disorder, also known as HAND, has long been seen in HIV-positive individuals. With the introduction of antiretroviral therapy (ART), the cases of HIV-associated dementia (HAD), the most severe variation of HAND, have dropped. Regardless of ART, other milder forms of HAND are still present along with other signs of chronic neuroinflammation. Inflammasomes are multiprotein oligomers that are part of the innate immune response and responsible for inflammation. One of the most abundant and most studied inflammasomes is the NLRP3 inflammasome. There are two signals that activate the NLRP3 complex. The first signal is known as priming, while the second signal is known as activation.

Priming allows for the transcription of the NLRP3 protein, proIL-1 β , and proIL-18 via the NF-κB pathway. The second signal is what allows the NLRP3 complex to be assembled. In this review we will be focusing on transcriptional priming. A 2017 study from the University of Nebraska Medical Center specifically tested HIV-1 Tat protein and how it related to the NLRP3 inflammasome. This study found that Tat was able to prime the inflammasome complex by upregulating NLRP3 expression. A seperate 2012 study found that HIV-1 Tat can activate the NF- κB pathway by interacting with I κB- α and p65. Regardless of many studies done, it is still necessary to confirm the relationship between HIV-1Tat, NLRP3, and NF- κB. Doing this would allow Tat and NF- κB to be targeted as potential inhibitors of NLRP3 expression and subsequently reduce HIV- associated neuroinflammation. In this study we hypothesize that NLRP3 expression will be upregulated by HIV-1 Tat activated NF- κB. By using mutated Tat proteins lacking cysteine-rich sequence and arginine-rich sequence, which have been shown to be necessary for binding to I κB- α and p65, we expect to see a drop in NLRP3 expression

as compared to normal wild-type Tat proteins.

**FATIMA KARKOUB; DR. CARLO COLANOTUONI**

## A Public Multi-Omics Data Environment for the Exploration of CNS Function in HIV Infection

The Human Immunodeficiency Virus is a disease targeting CD4+ cells of the immune system. Once the virus is in the system, through viral tropism, the virus infects other regions of the body including the brain. In the early stages of infection, up to 60% of HIV+ individuals develop cognitive impairments, and rates remain high for suppressed plasma HIV RNA individuals, suggesting HIV associated Cognitive Impairment (HIV-CI) may be related to neurotoxic effects of therapeutic interventions such as the combination antiretroviral therapy (cART) or the virus itself. In the Colantuoni Lab, they have designed an interactive digital web portal, NeMO Analytics, to integrate HIV multi-omics data to visualize data harvested from world-wide CNS studies of HIV. This multi-omics exploration environment enables scientists to query data sets gene-by-gene and integrate their own data into the platform. Previous studies utilized gene clusters, using NeMO Analytics, across animal models and human tissue analyzing cells within white matter of the brain, frontal cortex, or the Basel ganglia. Findings included significant overlap was present illustrating age dependent expression in the post-mortem brain tissue of HIV associated encephalitis (HIVE) patients and transcriptional program activated microglia in the brain tissue of HIVE, suggesting that on top of microglia cell numbers, cell activation states are present in HIVE. Currently we are working with fellow, Dr. Audrey King, to harvest data from CNS related HIV literature. We are focusing on experiments with mostly expression profiling by high throughput sequencing or array, with a wide range of literature ranging from transcriptome sequencing of gene expression in the brain of HIV transgenic rats to studying the patterns of gene dysregulation in the frontal cortex of patients with HIV encephalitis. The literature is studied, and the data is curated using R programming to synthesize gene observations and expressions. The data is then uploaded to NeMO Analytics where users can choose to apply dimensional reduction tools to define modules of systemic change in their data set of interests. NeMO Analytics will be further utilized as a multi-omics exploration environment using complex computation interrogations to the identification of therapeutic targets of HIV-CI.

**EDIAN CUEVAS**

## Elevated intracellular Calcium in Schwann cells directly impact neurons may contribute to HIV-induced peripheral neuropathy

A Painful peripheral neuropathy is a common HIV-induced complication whose cause remains unknown. Prior publications have shown that Schwann cell lysosomal exocytosis of ATP into the extracellular space contributes to neuropathic pain in patients living with HIV. ATP is released by Schwann cells either by hemichannels or lysosomal exocytosis, but it has not been established which of the two has a greater contribution to ATP release in HIV patients. HIV-gp120 appears to be the primary cause of neurotoxicity. It promotes calcium-dependent lysosomal ATP exocytosis in Schwann cells, which may lead to ATP-activation of lysosomal P2X4 receptors on Schwann cells and DRG neurons. Activation of these receptors increases intracellular $Ca^{2+}$ levels that impact the function of Schwann cells and generate cytosolic reactive oxygen species in DRG neurons. This suggests communication between Schwann cells and neurons, but does ATP from Schwann cells or elevated intracellular $Ca^{2+}$ in Schwann cells directly impact neurons? We will evaluate these 2 questions in Schwann cell and DRG neuron monocultures. Using calcium chelators, P2X4 inhibitors, and techniques to isolate ATP-containing lysosomes from Schwann cell culture media, we will evaluate the relationship between gp120-induced

calcium release from ER and Schwann cell P2X4- induced Ca²⁺ flux interfering with DRG neurons.Conducting these experiments, we expect to see whether the increase in Schwann cell calcium levels and lysosomal ATP release directly impact neurons. Through the experiments in HIV-gp120 cell culture, we hope to better identify the critical cell biological pathways that may contribute to HIV-induced peripheral neuropathy. These studies may ultimately inform further experiments in animals to test these hypotheses in vivo. Although there are inhibitors that silence mediates purinergic receptors, following ATP, Ca²⁺ signal elimination, there are no known related mechanisms for ER, purinergic receptors, and the possibility of these having a role in mediating pain.

Keywords:
gp-120, endoplasmic reticulum, extracellular calcium, Schwann cells, DRG neurons, P2X4R.

## KYRIAN ELEKEWACHI

### Theta Oscillations as a Biomarker for tracking Neurotransmission in Hippocampus in HIV Patients

Thirty years after its epidemic, human immunodeficiency virus (HIV) still affects approximately 38 million people across the globe. The emergence of antiretrovirals has provides an effective therapeutic for reducing the severity of HIV. The application of antiretroviral therapy has decreased morality rates and increased life longevity, however; HIV associated neurocognitive disorders (HANDs) still remain prevalent. While many studies have correlated neuroinflammation and HANDs, a few studies have examined how neurotransmission is affected in this process. A recent study proposed a link between HIV entry and Ca2+ flux in dopaminergic neurons. A higher concentration of K+ and Ca2+ ion flow in neurons stimulates the release of neurotransmitters to create a cycle of excitotoxic cell death. This release of neurotransmitters is notable for modifying the functions of different neuronal subtypes. (e.g. glutamatergic, cholinergic, and GABAergic neurons) In this study, we will investigate the expression of GABAergic, cholinergic, and glutamatergic neurons in the hippocampus using theta oscillations. Theta oscillations may be correlated with ion flow across neuronal axons, which provides a way to assess inhibition and/or excitation of these neurons. Fluctuations in the frequency and amplitudes of theta oscillations may provide a means of tracking dysfunctional neurotransmission in HIV patients.

# HANNAH GREAVES

## Role of the Heat Shock Protein-90-Stress Response in HIV-1 and HIV-associated Comorbidities

It is known that those diagnosed with HIV-1 who have experienced or are currently experiencing high levels of stress tend to have poor health outcomes. However, the molecular mechanisms by which stress contributes to these poor health outcomes in many HIV-1 infected individuals is still unknown. Following exposure to an environmental stressor, cortisol, a glucocorticoid known as the stress hormone, is released. The glucocorticoid receptor (GR) typically exists in the cytoplasm as a hetero-oligmer of the GR, and various molecules of HSP-90, HSP-70, and HSP-56 (1). Once cortisol is released, it freely passes through the cellular membrane and the hetero-oligmer dissociates, allowing cortisol and GR to bind to various sites in the DNA of that cell (1). Following cortisol exposure, HSP-90 mRNA is significantly increased (2), and is abundant in limbic system related structures. HSP-90 is known to allow and sustain accumulation of toxic aggregates produced by faulty neurons (3), suggesting that HSP-90 may have a role allowing HIV-1 neurological comorbidities to develop and persist. Previous studies have also shown that HSP-90 inhibition reduces HIV-1 tissue reservoir development (4), suggesting that it also plays a role in allowing HIV-1 to develop and persist as well. This study examines the role of HSP-90 in HIV-1 and HIV-1 related comorbidities following exposure to stress.

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**VALINA DAWSON, AYOTIMOFE IDOWU, LIKAI LIU**

### DAMPs: Understanding the Connection Between Neuroinflammation and Parthanatos in
### Relation To Parkinson's Disease

Neuronal cell death is one of the hallmarks in neurodegenerative diseases. While neurons respond to multiple cell death stimuli, dopaminergic neuron loss in Parkinson's disease is mediated primarily by necroptosis and parthanatos. Parthanatos is a unique cell death pathway triggered by oxidative stress, hypoxia, or inflammatory cues and exerts cytotoxic effects via hyperactivation of poly(ADP-ribose) polymerase-1 (PARP-1). Not only is PARP-1 an essential in DNA repair and genome maintenance, but it is also an important pro-inflammatory protein. Further experiments are required to clarify the relationship between parthanatos and neuroinflammation, as well as the therapeutic benefits of parthanatos inhibition. It has been previously found that PARP-1 induces cytokine expression and their release from immune cells promotes inflammation. Likewise, the hyperactivation of PARP-1 would produce neuroinflammation through the cell death pathway involving the mitochondria. Damage associated molecular patterns (DAMP) specific to the mitochondria plays a critical role in the initiation of inflammatory immune responses through activation of neuroglial (e.g astrocytes). Furthermore, it was established that microglia can readily adapt to any changes in immunity which is done by inducing an inflammatory response. As of right now, it is unclear what role DAMP plays as it relates to PARP-1. It is possible to modulate neuroinflammation as a means to neuronal cell death. Therefore, the goal of this research is to determine whether DAMP binds to neurons and subsequently activates a signaling pathway leading to parthanatos. To do this, two neuronal cell cultures would be prepared, one wildtype and the other PARP-1 deficient. Then, we would investigate the characteristics of their binding with relation to DAMP. If it is true that DAMP could activate a signaling pattern that triggers parthanatos, then it could guide us in finding a way to inhibit parthanatos which could be translated into hindering the emergence of Parkinson's disease.

### OLIVIA MORRISSEY

### Validating Virus Efficiency after 18 Months of Delivery

TDP-43 is an essential RNA binding protein that represses nonconserved cryptic exons. Loss of function of this protein is linked to neuron degeneration in ALS, Alzheimers, and dementia. This outcome makes TDP-43 a good target for viral replacement in order to rescue the neurons present. The effects of the loss of function of TDP-43 has been studied in knock out mice models, demonstrating neurodegeneration in the hippocampus CA2/3 area. This neurodegeneration has been remedied with an AAV9 virus to replace the nonfunctional TDP-43 protein with a functional TDP-43 protein. The purpose of this experiment is to determine the success and longevity of the virus in restoring TDP-43 functionality. To this end, mouse hippocampi were stained with three different antibodies

18 months after viral injection. hTDP-43 antibodies were used to identify the injected virus, mhTDP-43 antibodies were used to identify both endogenous mouse TDP-43 and TDP-43 from the injected virus, and NeuN was used to stain all neurons. Thehippocampal stains from the knockout mice 18 months after injection were analyzed by counting the number of neurons in the CA1 and the CA2/3 areas. These counts can then be utilized to determine the success of the knockout in the mice and whether the virus is still effective after 18 months. We hypothesize that after 18 months, there will be little to no activity remaining from the virus because the expected lifespan is between 9 and 12 months. Additionally, we expect the success of the knockout to be demonstrated in the mhTDP43 stains, which will be supported by higher numbers of endogenous mouse TDP43 than the viral TDP43.

**SUWI MUWOWO**

## The Role of Osteopontin-dependent Modulation of ERK-1/2 Cascade in HIV-1/gp120 Induced Neural Damage

Osteopontin is a multifaceted, secreted bioactive glycoprotein that is implicated in numerous biological processes; however, the implication of osteopontin in HIV-mediated neurodegeneration is largely unknown. In this study, we will investigate the novel role of osteopontin in human immunodeficiency virus, particularly focusing on the signaling molecules Extracellular-Signal related Kinases (ERK 1/2). Various studies have shown that several factors directly derived from the virus (e.g., gp 120, Nef, Tat) or indirect host factors include increased production of cytokines, specifically Fractalkine (CX3CL1), as well as interference with the production or action of neurotrophic factors which lead to HIV-induced neuronal damages. These chemokines contribute to neurodegeneration through the initiation of inflammatory cascades and the induction of neural signaling and apoptosis. We hypothesize that when Fractalkine binds to CX3CR1, osteopontin regulated ERK 1/ 2 is activated, which stimulates the release of TNFα and other key neurotoxins detected in HIV-associated neurocognitive disorder (HAD). The clarification of specific pathways through which Fractalkine induces brain macrophage/microglial activation and regulates the production of neurotrophic and toxic factors will be critical in understanding neurodegeneration in HIV.

**MARIA RIVERA-SANTANA**

## Neuroenginnering and Biomedical Instrumentation Lab

Cerebrovascular autoregulation (CVAR) is a homeostatic mechanism used by the brain to maintain cerebral blood flow (CBF) at a constant level within limited ranges of mean arterial pressure (MAP). When MAP values reach levels outside these ranges, like is the case during cardiac arrest (CA), CVAR becomes impaired and thus CBF becomes pressure dependent. In cardiac arrest (CA), epinephrine is used to increases the probability of having a return of spontaneous circulation (ROSC) after CPR, which in turn could be relevant for the restauration of CVAR. Given the high prevalence of CA and the neurological damage that can arise when CVAR is impaired, it is important to better understand the ranges at which CVAR becomes impaired after CA and the effects that epinephrine can have in CVAR restauration. To evaluate this, an established CA rat model was followed to record the measurement of MAP and CBF parameters at baseline, washout, asphyxia, CPR, and ROSC periods. Thirteen Wistar rats were subjected to this model in two groups, having either 5 (n=6) or 7-min (n=7) asphyxia times. Two rats from each of these groups also underwent an epinephrine administration post-CPR. Pearson correlations, linear regression and analyses of cerebrovascular resistance will be used to identify autoregulation in this CA rat model. We hypothesize that findings from these analyses will reveal that CVAR becomes impaired after asphyxia and could be slowly recovered at later experimental periods. Moreover, we expect to see changes in MAP post-CPR and a quicker restoration in CVAR in the rats who were administered epinephrine vs those without the drug.

**MALIKA SHAH**

## Tracing Branching Neurons in Three-Dimensional Space with Deep Reinforcement Learning

In our work, we set the goal to trace axonal arbors from microscopy images of a mouse brain using deep reinforcement learning. With further improvements in microscopy imaging techniques of the brain, multitudes of data have been compiled. Within this data are high resolution images depicting the neurons and their pathways to and from different areas of the brain. In the process of analyzing this data, tracing and reconstructing the axonal arbors of the neuron represents a major bottleneck, since it is a manual and time-intensive process (Winnubst, et al., 2019). Some improvements to decrease the effect of this burden include pre-processing segmentation algorithms and using Convolutional Neural Networks(CNN) as a classifier-based approach (Peng, Ruan, Long, Simpson, & Myers, 2010). More recently, (Dai, et al., 2019) have shown another avenue: deep Reinforcement Learning. Deep reinforcement learning is promising as one can see from previous works concerning vessels tracing relating to cardiology and muscle fibers tracing. We aim to build upon the approach of (Dai, et al., 2019) by using their framework and extending the algorithm to interact with a three-dimensional environment, as well as encompassing situations in which axonal arbors branch. Neurons occupy three-dimensional space and branch into smaller arbors, making our proposed approach central to improve the accuracy and feasibility to trace axonal arbors. Using an actor-critic model, we utilize three dimensional CNNs to achieve a continuous action-state space tracking. We primarily train our neural networks on synthetic three-dimensional images of the axon with variable noise. Using real two-photon microscopy images of the mouse brain from Janelia Research Campus, we test our model. We hope to increase the versatility and accuracy of the algorithm, so that tracing axonal arbors is less labor-intensive and allows for a decrease in the bottleneck.

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**SARINAH WAHL**

## Improved Dynamic Programming Tractography of Meyer's Loop in Subjects with Normal Hearing and Hearing Loss

The optic radiation (OR) is one of the main components of the human visual system and the last stage of the visual pathway. It travels from the lateral geniculate nucleus to the primary visual cortex in the occipital lobe. However, it has complex anatomy as the Meyer's loop, travels upwards and around the temporal horn, eventually ending at the calcarine fissure. Due to its course through the temporal lobe these fibers interact with acoustic radiation (AR).  Thus we used dynamic programming to delineate the OR in 15 subjects 11 with normal hearing and 4 with hearing loss. Improvements in tractography were achieved through region-of-interest masking of Fractional Anisotropy (FA) maps. This method will allow us to explore the interactions between the AR and OR. The trajectory of the 3D tracts show that the method is successful and can be used in the future to analyze these interactions.

**ELIAS WOJAHN**

## Quantifying Circling Behavior in Mice

The vestibular sense is responsible for perceiving and interpreting motion and spatial orientation and can be studied in mice. Mice who exhibit vestibular dysfunction often display repetitive circling behavior. There are many known mice mutants which exhibit this behavior,but there exists a lack of standardization in how this behavior is reported. If the behavior is quantified it is usually in units of rotations/unit time, however there is no objective consensus what constitutes a rotation between researchers. These circling behavior tests serve as a good screen for identifying mutants that may be valuable for further vestibular research. Currently existing technologies are expensive, inflexible, and unable to accommodate a wide variety of environments.

The purpose of the project is to design a versatile, cheap, and easily followed methodology for quantifying circling behavior, with the intent of offering other researchers a clear objective standard from which to report repetitive circling. To achieve this, the open-source software DeepLabCut is used to track the position of circling mutants versus control mice, while the remainder of the platform calculates rotations, speed, and the diameter of the rotations. To motivate the need for this new methodology, I first performed a thorough literature search. My literature search revealed the wide potential for use among various mouse mutants, different circling definitions that have been used previously, and pre-existing products that attempt to accomplish the same tasks. My future work includes testing and analysis of data recorded in different lighting conditions to demonstrate the robustness of the methodology.

# ASHLEY YIM

Osteopontin (OPN) is an extracellular matrix protein that has been shown to play a role in the inflammatory system, exhibiting both pro-inflammatory and anti-inflammatory processes.Taking a closer look, the cleavage of OPN by thrombin into fragments OPN-C, possessing the C-terminus, and OPN-N, possessing the N-terminus, has shown to heighten functions of full-length OPN (OPN-FL) and activate other activities as well. OPN-N, possessing the RGD motif, has a greater binding capability with RGD-dependent attachments. In bone marrow, OPN-N is the predominant form and mediates the chemotaxis of hematopoietic stem cells through attachment with a9B1 and a4B1 integrins. In multiple sclerosis, OPN-C seems to be the prevalent form and helps mediate CD44 attachments. Additionally, previous studies in different disease models have shown that the predominant forms of OPN, OPN-FL, OPN-N, OPN-C, exhibiting different degrees of phosphorylation change with each region and disease. HIV-associated neurocognitive disorder (HAND) is one of the conditions that may arise due to HIV infection. Activation of the inflammatory system and lack of controlling its levels after is thought to be a major cause of the onset of HAND. HAND affects the individual in cognitive, motor, and mood aspects and works in conjunction with HIV to worsen the conditions of individuals. Current information about the relationship between OPN and HAND is minimal. As OPN is an important protein when analyzing inflammation and seeing that it is associated with other neuroinflammatory diseases, it is vital to uncover the interrelation between OPN and HAND. Utilizing a humanized mice model of HAND , we will isolate, characterize and quantify OPN proteins from brain tissue using allele- and fragment-specific antibodies with Enzyme-Linked Immunosorbent Assay (ELISA) diagnostic analysis. This experiment aims to identify which OPN variant is predominant in each region of HAND-infected brains to advance current research about potential treatments for HAND. Identifying which predominant form is exhibited in each region of the brain upon onset of HAND helps to narrow future studies. It is vital to learn more about the specific molecular actions of OPN that occur at the onset and ongoing inflammation process that eventually leads to the genesis of HAND.

**SUMMER ACADEMIC RESEARCH EXPERIENCE (SARE)**

## SHANTIKA BHAT
## Health Disparities disproportionately affecting African American Populations during COVID19

COVID-19 is currently having devastating impacts on the world. So far, there have been more than 138,000 deaths in the United States and cases are on the rise. Data from various resources such as Johns Hopkins School of Medicine and New York Times have shown that COVID19 has significantly higher mortality rates in African American populations when compared to White populations. According to the Atlantic magazine, nationwide, African Americans are dying at 2.5 times the rate of White people and accounting for 23% of COVID19 deaths. The purpose of this research is to understand why African Americans are dying at higher rates. In order to better understand this phenomena, I will specifically focus on Baltimore City. Baltimore city is no stranger to the health disparities experienced by low-income and African American people. The health disparities referenced here include lack of access to testing for COVID, healthcare, awareness, and resources. In addition there is unfair housing distribution, stress, and unfair employment policies that are health disparities. Aside from the already known health disparities this pandemic revealed new disparities that need to be addressed such as lack of access to vital media and technology.  All of these are actively contributing to the vulnerability of African Americans in the face of a pandemic. Action and awareness must be spread in order to eradicate these current disparities and alleviate their undue stress on African American lives.

**KRISTIANA SMITH**

## Exploring localization of chromatin-organizing factors during the cell cycle

During interphase, the genomes of complex eukaryotes are spatially segregated into A-compartments (containing actively transcribed genes) and B-compartments (containing inactive genes). A-compartments contain looping structures of self-interacting chromatin called topologically associated domains (TADs). B-compartments, however, are condensed regions of chromatin near the inner-nuclear membrane called lamina associated domains (LADs). A gene's presence at the nuclear lamina is associated with gene silencing and the composition of LADs varies between cell type and function. Understanding the mechanisms that drive LAD organization will lead to a further understanding of the principles that guide cell differentiation and the selective expression of the genome. It remains unclear how the 3D organization of chromatin is established during the cell cycle. There are many proteins and histone modifications that are suspected to contribute to inner-nuclear scaffolding. With the use of cellular constructs and immunofluorescence the localizations of proteins Emerin, G9a, and Lap2 were imaged.  These proteins compose the nuclear proteome and potentially interact with chromatin. Resolved images have allowed us to conclude that Emerin localizes at the nuclear periphery consistently throughout nuclear reconstruction, however, G9a is nucleoplasmic. Interestingly, Emerin does appear to associate with mitotic chromosomes throughout anaphase while the localization of Lap2 overlaps with the reconstructing nuclear membrane.  These results implicate that Lap2 and Emerin may participate in genome organization at the nuclear periphery.

# CENTRO SOL SALUD/HEALTH AND OPPORTUNITIES FOR LATINOS

**ADRIANA ALARCON**

## Awareness of Major Risk Factors of CVD in the Latinx Population in the U.S.

Cardiovascular disease (CVD) is defined as a range of conditions that affect the heart function (American Heart Association). Examples of CVD's include Coronary Artery Disease (CAD), heart attack, arrythmia, heart failure, congenital heart disease etc. (American Heart Association, 2017). These diseases are the leading cause of mortality in the United States for most ethnicities, all for the exception of one the Hispanic/Latinx population (NCBI, 2016).Studies have found that within the Latinx population the number one cause of death is cancer, making CVD'S the 2nd leading cause of death (Pelberton, 2016). Moreover, the prevalence of which these diseases present themselves within the Latinx population are relatively high, consequently fueling the growing need for further research into the understanding and prevention of these condition. Studies surrounding the Latinx population have also suggested that there are several factors that correlate to this lack of understanding including cultural background, demographics, and age. The following will discuss the findings of the awareness of major risk factors at hand that lead to CVD in the Latinx population within the US.

**JACQUELYN AMAYA**

## The Effects of Music Therapy in Patients with Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a developmental condition that has a specific combination of impairments in social communication and repetitive behaviors/sensory behaviors usually diagnosed in early childhood (Lord, 2020). Over the years, there has been an increased prevalence of diagnoses for ASD. Individuals with ASD struggle to adjust in a world filled with social cues and communication due to their inability to effectively detect and perceive these cues and communication skills. One of the methods used to cope with ASD is music therapy, which is the use of music as a therapeutic tool to address patients' physical, cognitive, emotional, and social needs (Stegemann, T, et al., 2019). Studies were conducted on children diagnosed with ASD, with which music therapy had shown an improvement in their social communication, behaviors, and emotional well-being. As more children are diagnosed with ASD every year, it is important to know and understand the various treatments and therapies available, to ensure that children have the proper care and prognosis. With music therapy specifically, affected children can improve their social abilities and live more cohesively with others. The research conducted is a culmination of studies assembled to investigate the overall result of music therapy in either improving or sustaining conditions for children with ASD.

**MAYDELI AVILA**

**Substance Abuse Among the Latinx Youth**

The Latinx community is one of the largest and fastest growing populations in the United States. There are about 60 million Latinx living in the U.S., and about half are younger than 18 years old (Duffin, 2020). The consumption of drugs has become a serious issue in the Latinx community with 62% of teens having been offered drugs, such as ecstasy, crack/cocaine, heroin and methamphetamine (Partnership Staff, 2013). About 21% of Latinx parents' response to drug consumption among their children is that they have no problem with it (Rodriguez, 2013). There are many factors that force Latinx youth to consume drugs. This includes the environment, misinformation, influence of social media, family history of substance abuse, and exposure to traumatic events (Mosel, 2019). Most Latinx youth use illegal substances, increasing their chances of overdose or developing substance abuse disorders. In order to recover from substance abuse, individuals have to realize there is a problem; this the first step towards recovery. According to the Substance Abuse and Mental Health Service Administration, Latinx youth aged 12 and older, required substance abuse treatment but were less likely to receive it at a specialty facility, resulting in about 3.1 million Latinx youth not receiving treatment. This was due to the lack of access, insurance, language barrier and fear of deportation. In order to help individuals who, suffer from substance abuse, first need to recognize that there is an issue at hand. With providing families with support groups, their adolescents can then be educated on the issue of overdosing and substance abuse.

**ARLY BENCOSME**

**The Effects of Air Pollution on Respiratory Diseases**

Global warming is becoming a growing worldwide problem, caused by the air pollution that traps the sunlight and solar radiation within the Earth's atmosphere (MacMillan, 2016). This pollution is mostly due to human activities, such as the use of factories, cars, power plants, and chemical fumes. It can also result from wildfires, volcanic activity, pollen dispersal, and natural radioactivity (Green, 2020). One of the most noticeable effects of global warming is the increase in temperatures around the world. Consequently, sea levels are rising, heat waves and forest fires are constantly occurring, and more air pollution is being produced (D'Amato et al, 2013). In the past decades, air pollution alongside airborne allergens have been negatively affecting those with respiratory diseases and allergies, which has been proven to not stop anytime soon (D'Amato et al, 2013). Many studies have researched the association between air pollution, hospital visits and admissions for respiratory diseases in different parts of the world (Atkinson et al, 2001). The first and second Air Pollution and Health: a European Approach (APHEA) projects were conducted in European cities where models were created to appropriately control confounding factors for each individual age group that was examined. The following will discuss the findings of the various studies conducted in these European cities.

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**EMILY DIAZ**

## The Effects of ELL Programs that Inhibit Success in the Latinx Community

English Language Learner (ELL) programs are used in schools to improve and develop English speaking and writing skills in students whose second language is English. The Spanish speaking ELL students make up the majority with around 3.8 million students. In Maryland, the rate of these students graduating is 54% compared to the average of total graduating students, which is 86.4%. These low rates of graduating ELL students bring up the question, why are ELL Latinx students more susceptible to dropping out? It is crucial to identify the issues within the Latinx English Language Learner (ELL) programs, more specifically in Maryland, who make it ineffective in motivating their students to pursue and create higher educational goals. Researchers utilized surveys and interviews conducted on teachers, that questioned their feelings on being good ELL teachers and having necessary resources for their students. Based on the findings, teachers believed they needed more tools and to be more aware of their students' situation (Goldstein 2012). The following will examine the factors and findings for what will propagate the academic advancements of Latinx ELL students.

**LESLIE FUENTES**

**<u>Stigma Surrounding Mental Illnesses in the Latinx Population</u>**

In the Latinx community, there is a negative stigma surrounding the topic of mental illness. Mental illnesses are health conditions involving changes in emotion, thinking or behavior" (Parekh, 2018). In a study conducted, it had shown that "Latinos expressed greater shame and embarrassment about having a mental illness" (Jimenez et al., 2013). Studies have found that many Latinos fail to mention any sign of mental illness due to religion, as it is believed that mental illness correlates to demons, lack of faith, etc. (Caplan., 2019). In the Latinx population, many find that mental illness is taboo or unreal unless it is physically affecting a persons' way of living (Calan, 2019). It is important to understand mental illness, for which the suicide rate in the Latinx population is 3.7% (Karch et al., 2004). Surveys have also shown that when asked, the Latinx participants

felt embarrassed when speaking about mental illness, and some did not believe mental illness was a real disorder. The following will dive deeper into the discussion surrounding mental health, how it impacts the Latinx population, and what the suggested treatments are.
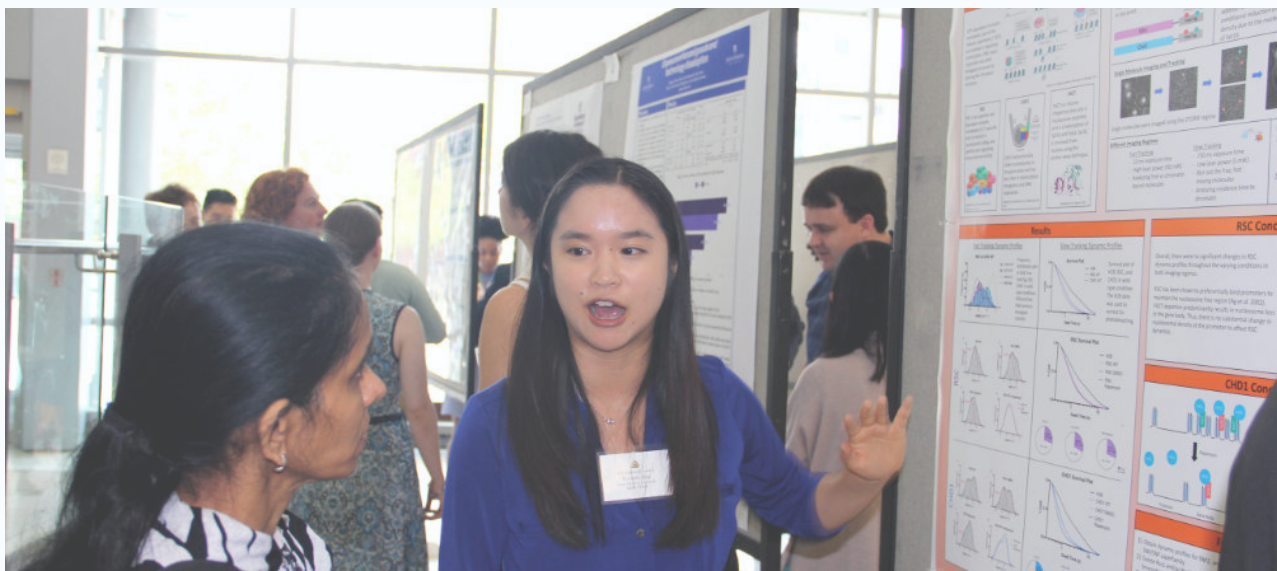
**EVELYN MALDONADO**

## The Effects from the Shortage of Interpreters in the Latinx Community

According to "The Journal of Pediatrics" the lack of interpreters in the United States is increasing over time. This is impacting the Latinx Community in a negative way. Members in the Latinx Community continuously struggle to acquire an interpreter for their children's appointment or their own. As a result, some parents may choose to forgo their children's' medical appointments, or even emergency room visits, due to the lack of interpreters. The scarcity of interpreters is negatively impacting the health and well-being of Latinx patients. According to "The Journal of Pediatrics," there have been countless examples given in which Latinx families do not have interpreters at their disposal during medical appointments, resulting in missed diagnosis, prognosis, and treatment of the ill family member. The following will discuss the intricacy and effects that the scarcity of bilingual interpreters in a medical setting have on the Latinx population.

**GUADALUPE MALDONADO**

**Acute Lymphocytic Leukemia in the Hispanic Community**

Leukemia is the most common type of cancer in children younger than 20 years of age (Barrington-Trimis, 2015). It is a cancer that stems in the body's blood-forming tissues, with various forms existing. These various forms include Acute lymphocytic leukemia, Acute myelogenous leukemia, Chronic lymphocytic leukemia and Chronic myelogenous leukemia (Mayo, 2018). Symptoms vary from person to person, but some common ones include fever or chills, persistent fatigue, weakness, losing weight without trying and more symptoms (Mayo,2018). In the Hispanic population, the highest rate of leukemia patients are children. From the year 2007 to 2011, a total of 5,412 children under the age of 20, were diagnosed with childhood leukemia. Out of those 5,412 patients, 2,071 were Hispanic alone, with the other 3,341 being non-Hispanic. The Hispanic population is at a higher risk for Leukemia due to their lifestyle, classification and environment. Other risk factors for childhood leukemia include childhood atopic conditions, pesticide exposure, maternal and child weight. The following will discuss these factors in depth and why the Hispanic population is at higher risk for Acute lymphocytic leukemia.
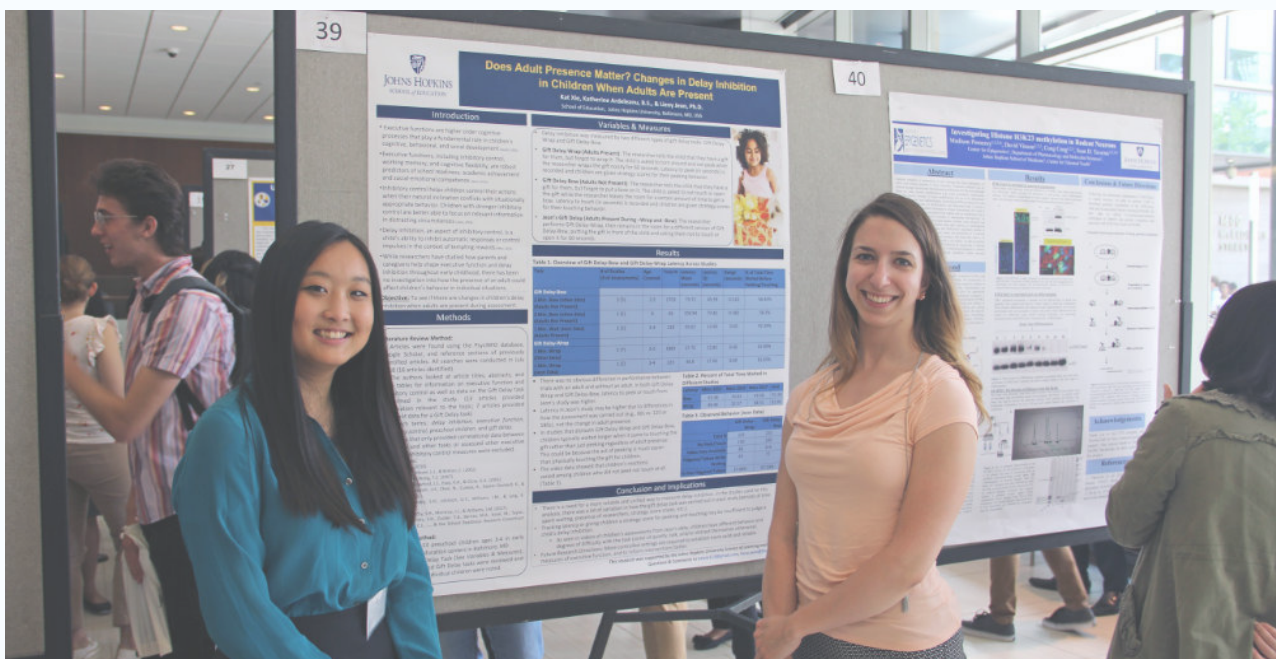
**KELLY SIBRIAN**

## Anxiety and Depression Among the Latinx Community

As more children are diagnosed with anxiety and depression in the United States, many of them find reliable access to a treatment and prognosis. However, a population that is consistently overlooked is the immigrant children (Denis, 2018). Many Latinx immigrant children do not have access to healthcare, resulting in the lack of proper care for mental disorders such as anxiety and depression (Blossom, 2019). In most cases, traditional cultural beliefs surrounding trauma and mental health are contributing factors to the rise in anxiety and depression diagnosis within the Latinx population, specifically immigrant children. Language barriers along with the lack of interpreters in the healthcare settings also affect a child's ability to receive proper treatment. After utilizing surveys at schools and hospitals, collecting the data from clinics on children's mental health, and viewing statistics of youth in the Latinx population, it has been observed that this is still a continuing issue. The lack of mental health care for the youth in the Latinx population has not yet been resolved and it is steadily rising (Alison, 2019). In order to fix this problem, it has been suggested that the immigrant parents in the Latinx community need proper education and information on these mental health problems, in order to facilitate the correct treatment for their children. The following will discuss the various options and tools needed to treat and aid immigrant youth suffering from anxiety and depression.
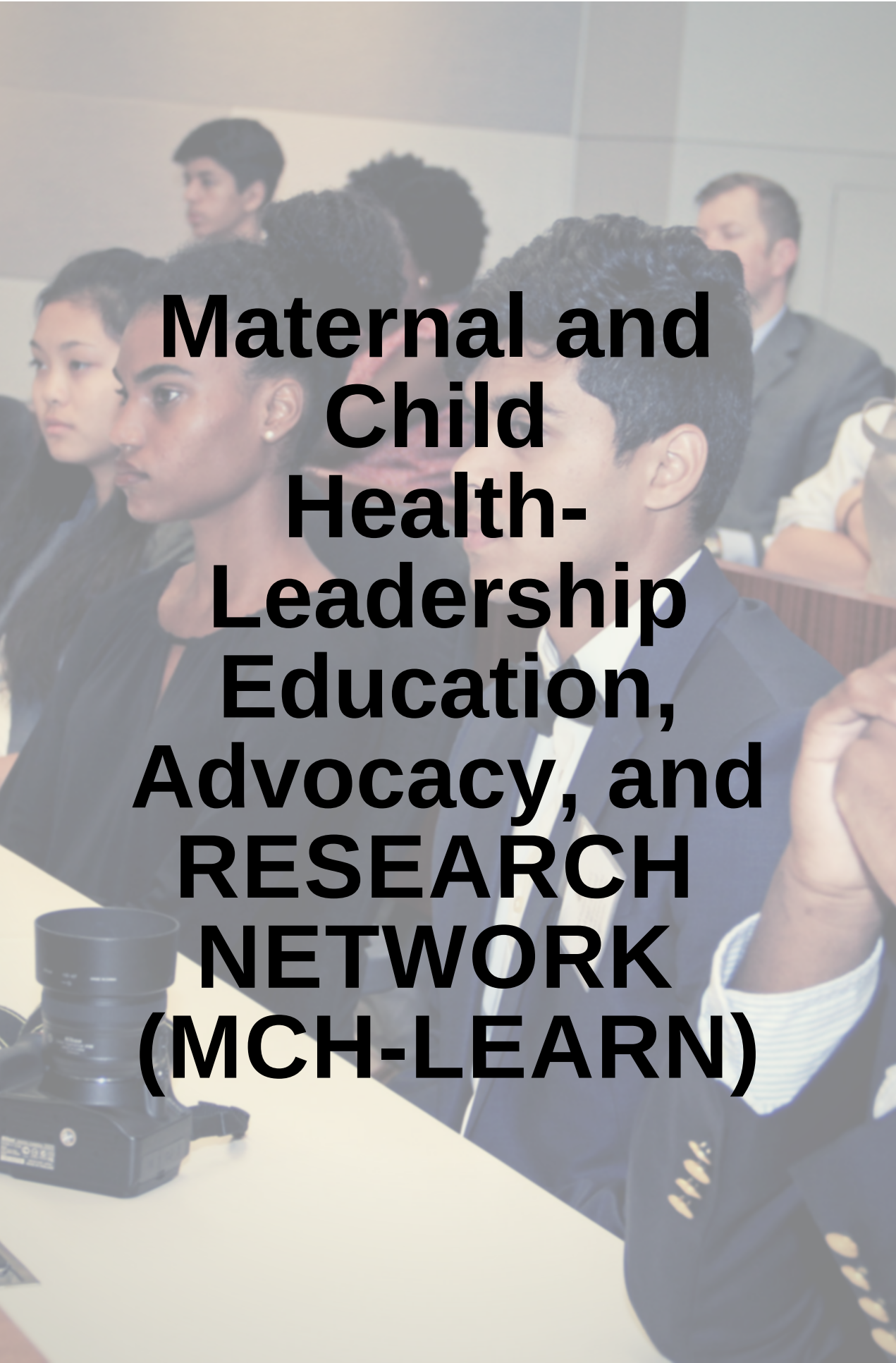
**ERICK BAIRES-ZAVALA**

**Impacts Undocumented Status has on Latinx Population in the U.S.**

Political, racial, terrorism and economic factors contribute to immigration policies in the U.S. that have significantly impacted the social determinants of health of undocumented Latinx people. Undocumented immigrant status is determined by several factors: surpassing the timeframe that a visa/permit allows to visit or work in the U.S., refugee/asylum application is denied but the individual remains in the country, cannot renew residence permit due to socioeconomic factors, entering the country using false documents, or unlawfully entering the country (Martinez et al 2013). It has been shown that undocumented workers are excluded from benefitting from publicly funded federal programs like healthcare, food stamps, housing subsidies, and disability benefits (Personal Responsibility and Work Opportunity Reconciliation Act 1996). Accessibility to these benefits significantly impact undocumented immigrants' health outcomes (Chang, et al 2019). This literature review was conducted using the Google Scholars literature database to search the keywords "undocumented workers social determinants of health". Although there are prominent articles that show how undocumented status and immigration policy have impacted this population's social determinants for health, there is a gap in literature discussing how recent immigration policy will impact undocumented immigrants' access to health (Chang, et al 2019).

# Maternal and Child Health-Leadership Education, Advocacy, and RESEARCH NETWORK (MCH-LEARN)

**NINA BRYAN**
Mentors: Bryan, N., Cannon, AD, McIntyre, T, Lance, EI

## Associated Risk Factors of Language-Based Disorders in Sickle Cell Disease

Sickle cell disease (SCD) is a genetic condition associated with various neurological complications, specifically silent cerebral infarctions (SCI) which is associated with cognitive impairment.  Cognitive impairment can include difficulties with attention, memory, and executive function that can impact learning. The aim of this study was to identify disease-related and neurodevelopmental characteristics allowing early identification of language disorders and learning disabilities in children with SCD.

Researchers performed a retrospective chart review of patients from a pediatric SCD clinic roster identifying patients with SCD who received comprehensive neuropsychological evaluations. Data extracted from participants' charts included age at evaluation, sex, SCD type, highest and most recent transcranial Doppler (TCD) velocities, and neurodevelopmental diagnoses. Twenty-nine participants met inclusion criteria. Majority of participants were male (n=18) and had a mean age at evaluation of 11.9 years (range 5-20 years).  SCD types included SS (41.7%), SC (11.1%), and S-β+-thalassemia (2.8%).

Nine participants with recorded TCD velocities had a mean maximum TCD velocity of 129 cm/sec with 56% located in the left middle cerebral artery (MCA). Participants' highest ($R2=-0.972$, p-value<0.01) and most recent TCD velocities ($R2=-0.997$, p-value<0.01) negatively correlated with NEPSY Spelling scores. Parent ratings of communication skills in young children (<12 years) was predictive of language and reading scores ($R2=0.495$, p-value=0.035).

Children with SCD are at risk for neurodevelopmental disorders, including language-based disorders. Participants with elevated TCD velocities in brain regions associated with language, particularly left/dominant cortical regions, may be particularly vulnerable and should be screened for language and learning disorders.

**VIVIAN FLANAGAN**

Mentor: Kamila A. Alexander, PhD, MPH, RN, Johns Hopkins School of Nursing

## Everyday Racial Discrimination Experiences, Cumulative Violence, and Substance Use among Black Young Men: Moderating Effect of Masculinity Norms

Due to contemporary and historical injustices, Black young men, ages 18-24, experience disproportionate exposures to everyday racial discrimination (ERD) and cumulative violence (CV) across the life course. Examples of CV include ACEs, Intimate Partner Violence (IPV), and Reproductive Coercion (RC). Masculinity is both a potential protective and risk behavior depending on sociocultural determinants. The current study examined interactions between ERD and CV exposure with substance use among Black young men in Baltimore. We hypothesized that beliefs about traditional masculinity norms may modify CV/ERD interactions with substances. Black Emerging Adult (EA) men (N=100) from Baltimore, Maryland were surveyed on their CV experiences, alcohol and marijuana use, and masculinity norms. Most young men (81%) experienced at least one type of CV. Among men who reported experiences of CV, 16% reported using RC, 32.1% reported using IPV, and 27.2% reported using emotional IPV with a romantic partner. A higher proportion of men with experiences of CV reported PTSD symptoms, depression symptoms, and comorbid PTSD and depression symptoms. Men who reported more ERD experiences (EDS>=14) also reported higher levels of traditional masculinity beliefs, PTSD symptoms, depression symptoms, and comorbid PTSD and depression symptoms compared to men who reported fewer ERD experiences (EDS<14) (P=.008). This study revealed high rates of CV and ERD exposure among EA Black men with consequences that affected mental health and substance use behaviors. Men with more traditional masculinity beliefs used more substances in the context of these exposures. Future research should further assess the relationships between masculinity beliefs and risk behaviors.

**MATTHEW HAILEMARIAM & MARCO GRADOS, M.D.**

## The Role of Parental Communication and Warmth on the Association between Violence Exposure and Mental Health among Adolescents

Background
Exposure to violence during adolescence can impact mental health. Healthy parenting practices, such as communication and warmth, have been shown to protect against these effects. Little research has shown how these buffering effects change across adolescence. The aim of this study is to evaluate the degree to which healthy parenting practices function as protective factors in the association between violence exposure and mental health and how its role differs across adolescence.

Methods
Data were taken from Wave I of the National Longitudinal Study of Adolescent to Adult Health, a nationally-representative longitudinal study administered in 1995. The participants (N=6,504) were aged 11 through 20 years and provided self-report on five variables used within this study: exposure to violence, conduct problems, depressive symptoms, parental communication, and parental warmth.

Results
A hierarchical multiple regression was used to find moderation effects for parental communication and warmth; no significant effects were found. Models were tested for participants 11 to 14 years and 15 to 20 years of age. A significant moderation effect of communication with parents was found for both 11 to 14 year olds (b= -0.09, p<0.05) and 15 to 20 year olds (b= 0.11, p<0.05) on conduct problems.

Conclusions
Parental communication resulted in lower risk of showing conduct problems from exposure to violence for 11-14 year olds. There was slightly higher risk of showing conduct problems for 15-20 year olds. Based on these findings, positive parenting practices may have differential effects depending on the age of the child.

**JACQUELINE LIU**
Mentors: Vini Singh MPH, Luther Kalb PhD, Ji Su Hong MD

**Comparing Apples and Oranges: Examining Developmental and Behavioral Differences Between Young Children with Autism Spectrum Disorder and Young Children with Developmental Delay**

Prior research indicates that earlier interventions for children with Autism Spectrum Disorder (ASD) and/or Developmental Delay (DD) are associated with positive outcomes later in the life course. Obtaining an ASD and/or DD diagnosis is a crucial step in receiving early interventions. Oftentimes, children with ASD or DD have similar presentation, making accurate diagnosis challenging. Still, little research has been done to examine the developmental and behavioral differences between these two groups. This study aimed to evaluate the differences in and relationships between ASD symptom severity/type, DD symptom severity/type, co-occurring psychiatric disorders, sensory issues, and parenting stress for young children with ASD and young children with DD. A case control study was conducted of 585 patients aged 12-60 months who were seen for ASD evaluation at the Kennedy Krieger Institute from 2012 to June 2019. Data was extracted from clinical records. Recorded measures included demographic information, the Autism Diagnostic Observation Schedule-2, the Mullen Scales of Early Learning, the Child Behavior Checklist 1.5-5, the Sensory Processing Measure, the Parenting Stress Index, and the Autism Parenting Stress Index. Of these 585 patients, 63 (10.8%) had ASD with no DD, 89 (15.2%) had DD with no ASD, 385 (65.8%) had ASD and DD, and 48 (8.2%) had neither ASD nor DD. In this preliminary study, the majority of young children referred to a tertiary diagnostic center for evaluation of ASD had both ASD and DD. Further developmental and behavioral data analysis will be conducted to determine characteristics that enhance earlier diagnoses of ASD/DD.

**MARIAMA MORRAY**

Mentors: Janiece Taylor PhD, Kamila Alexander PhD

## Research Disparities in Health Disparities: Social Determinants of Health and Nursing Research

The 2004 Annual Review of Nursing Research contributed to overall knowledge about health disparities research, but little is known about the literature in nursing research that connects social determinants of health and health equity. This scoping literature review aims to determine the scope of nursing research on the social determinants of health and its contribution to health equity attainment. This review included articles that described social determinants of health (SDH) as a predictor of a health outcome while excluding non-research articles, research not published in a nursing journal, and not in English. Articles within the inclusion criteria were categorized by Healthy People Social Determinants 2020 and structural interventions in the American Journal of Public Health. Articles fell within multiple social determinants and interventions. From 3491 search results, 216 articles were screened, and 35 articles met the inclusion criteria. The determinants of economic stability (n=10), education (n=12), neighborhood and built environment (n=20), health and health care (n=20), and social and community context (n=30) were all mentioned. For interventions, community and stakeholder engagement (n=40), scientific frameworks (n=3), research (n=17), innovations (n=4), cross-sector interventions (n=13), robust measures & methods (n=5), connected data sets (n=7), and decision-making tools (n=3) were included. Social determinants are often interrelated; interventions must span multiple sectors. Therefore, nursing curriculum addressing SDH should stress the inseparable connection between health and community to support holistic and most effective treatments.

**JASMIN THAMES**
Mentors: Dr.Andrew Zabel, Dr. Rachel Peterson

## Telehealth Satisfaction at Kennedy Krieger Institute during the SARS-CoV-2 Pandemic

Research from the first half of 2020 in the United States shows that the transition from in-office doctor visits to telehealth-based visits was successful based on high satisfaction ratings. There is little data on satisfaction ratings for pediatrics telehealth-based visits and how the type of services provided via telehealth affects satisfaction ratings. We examined recent Kennedy Krieger Institute caregiver survey responses to determine if age of patient and type of service received affects satisfaction ratings. Surveys were sent to caregivers of patients with a telehealth visit via Zoom between March and May 2020. The survey consisted of questions on overall satisfaction with clinical care and experience with telehealth. Respondents asked to complete the survey based on the most recent telehealth visit. Services were categorized into four types: medicine, therapeutic services, multidisciplinary, and behavioral health. Patients were grouped based on age: 0-5,6-10,11-15, and 16-20. Survey response rate was 27% (N= 1,864). The mean rating for willingness to use telehealth again was significantly lower for ages 0-5 versus all other age groups (mean 3.84, SD 1.24, $p < 0.05$). Therapeutic services were significantly different from behavioral health and medicine on the telehealth variable (mean 3.90, SD 1.24 $p < 0.05$). Younger children and those receiving hands-on/therapy services are more likely to rate telehealth lower. This may result from the restrictions telehealth places on engaging and comprehensively examining patients. Caregiver comments suggest difficulty engaging and observing children, particularly for therapeutic services. Future research is needed to determine ways to engage young children via telehealth.

**MADISON WILLIAMS**
Mentor: Carmi Washington Flood

## Translatable and Preventive Perinatal HIV Transmission Strategies

The transmission of the human immunodeficiency virus (HIV) poses a serious health threat to young adults throughout America. In Maryland (MD), the perinatal population has the lowest transmission rates due to the protocols that have been implemented over the past 20 years. The current study examined successful strategies to prevent perinatal HIV transmission for translation to other at-risk populations to improve health outcomes for young adults with HIV, specifically African Americans.

A literature search was conducted using the online databases PubMed, CINAHL, PsycINFO, and Google Scholar. Terms related to perinatal HIV transmission were combined to identify case studies and meta-analyses, which served as clinical evidence for different policies. Inclusion factors required that the paper was peer-reviewed and published 2015 or thereafter. Thirty-five articles met criteria. Two MD laws and regulations were examined.

Recurring translatable reduction of perinatal HIV transmission strategies found in MD were: (1) elimination of stigma, (2) comprehensive and accessible care, (3) early consensual rapid HIV testing, (4) immediate start of an antiretroviral regimen upon first positive test result, (5) confidentiality, and (6) mandatory reporting to county health officers. All guidelines fell within two MD statutes. One law contains two regulations related to effective protocols. All reduction of perinatal HIV listed were associated with decreased transmission rates in at-risk HIV populations.

These effective MD strategies, in addition to other identified practices, may be used to inform future policies to reduce HIV transmission rates in other high risk populations.

# BASIC SCIENCE INSTITUTE SUMMER INSTITUTE PROGRAM (BSI SIP)

**JASMINE AKOTO**
Mentors: Dr. Tao Wang, Dr. Mei Han

## Phenotyping Social Behaviors of Mice Carrying a Human Autism Mutation in GRIP2

Autism Spectrum Disorder (ASD) is a group of complex developmental disorders presented with social, communication, and behavioral challenges. Severe deficits in reciprocal social interaction are a core feature of these disorders  Glutamate Receptor Interacting Protein 2 (GRIP2), a neuronal scaffolding protein, plays an important role in regulating synaptic trafficking of AMPA receptor 2/3 (GluA2/3) and synaptic strength. Loss of function GRIP2 mutations have been discovered in patients with autism.  Mice

carrying a human mutation, Grip2-V664M, were generated to assess whether this mutation contributes to autism behavioral defects. A three-chamber social behavioral test was used to determine time spent with an empty cage versus a mouse in cage (sociability) and time spent with a familial mouse versus a novel (stranger) mouse (social novelty). The study cohort consists of 14 young adult male mice homozygous for Grip2-V664M and 10 wild type (WT) littermate controls that are matched for age, sex, and strain

 background. The study cohort consists of 14 young adult male mice homozygous for Grip2-V664M and 10 wild type (WT) littermate controls that are matched for age, sex, and strain background. Four sets of data on social interaction time were collected from behavioral test videos and compared between the cohorts of WT and Grip2-V664M mice. Preliminary data revealed that Grip2-V664M mice show a reduction of sociability compared to WT mice (mean ± SEM for time of interaction in seconds. WT, empty cage, 124.6±9.4; mouse in cage, 133.9±9.3, n=10; Grip2-V664M, empty cage, 158.5±10.8; mouse in cage, 106.7±11.2, n=14; two-way ANOVA, p=0.001). No difference was detected in social novelty between these two cohorts. Further studies of mutant mouse models are warranted to establish a role of Grip2-V664M in behavioral defects in autism.

**AMANDA D. BARRETO**
Mentors: Devin B. Mair, and Deok-Ho Kim

## Computational Analysis of Morphological Features of Glioblastoma Cells on Different Stiffness Substrates

Cell shape and movement are largely influenced by the underlying cytoskeletal network, including actin filaments.  Actin filaments, coupled with the actions of myosin motor proteins, largely allow for cell motility. Actin filaments are assembled into parallel bundles in filopodia or branched structures in lamellipodia. The aligned bundles of the filopodia at the front of the cell canonically allow unidirectional guidance, while the lamellipodia allow for mesenchymal migration. The actin-related protein (Arp) 2/3 complex nucleates branched actin in the lamellipodia, and previous studies have shown that cells migration in soft tissues, such as the brain, requires lamellipodia for effective migration. However, how branched actin enables migration on soft substrates, and the morphological changes that present when branched actin is inhibited, have not been well characterized. We hypothesize that inhibition of the Arp2/3 complex decreases cell size and aspect ratio. To test this hypothesis, images of glioblastoma cells cultured on varying stiffness polyacrylamide gels were acquired before and after they had been treated with CK869, an Arp2/3 complex inhibitor. The images were processed using a custom computational algorithm for area and aspect ratio acquisition. The results show that the area and aspect ratio of the cells decreased significantly after the CK869 treatment. These results suggest that the lamellipodium was disrupted, thus changing cell morphology and, consequently, its migration. In the future, an inhibitory treatment for the Arp2/3 complex could be generated to target glioblastoma cells in the brain and reduce the malignant growth in patients.
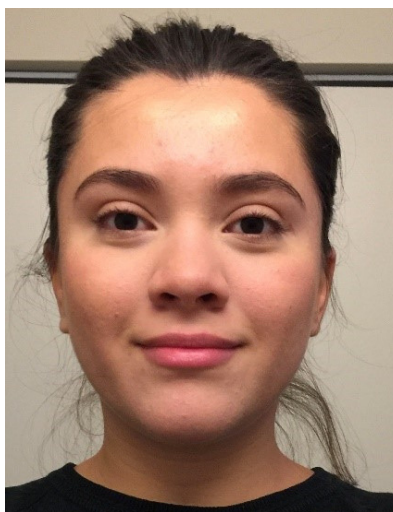
**BELLA CABRERA BRITO**
Mentors: Rachael Workman, and Joshua Modell

## Overexpression of DNA damage repair genes is associated with enhanced CRISPR immunity

CRISPR-Cas immune systems in bacteria provide their host with the necessary machinery needed to remember, target, and kill invading viruses and other mobile genetic elements. Previously, it was shown that in type II CRISPR-Cas systems, the long-form transactivating CRISPR RNA (tracr-L) functions as a single guide RNA that directs Cas9 to repress the Cas operon promoter. A deletion of the long-form tracrRNA (☐tracr-L) resulted in the 50-fold induction of CRISPR genes and a 3000-fold increase in CRISPR immunity in cells. Even though the loss of tracr-L enhanced immunity, cells exhibited slow growth, suggesting that high Cas gene expression could be cytotoxic. We studied the RNA profile of ☐tracr-L cells to find transcriptional responses that might explain the slow growth phenotype. RNAseq data obtained from wild type (WT) and ☐tracr-L cells was used to perform differential gene expression analysis with DESeq2 using R Studio. We found 33 differentially expressed genes between WT and ☐tracr-L. Interestingly, a number of these genes such as recF, uvrC, and mutL are associated with DNA damage repair pathways. This might suggest that the overexpression of CRISPR-Cas genes causes DNA damage in cells resulting in a toxic effect and slow cell growth. Future work in the lab will explore the mechanisms by which high levels of CRISPR-Cas components cause DNA damage.

**JOCELYN COHOLICH**
Mentors: Melania Bembea and Victoria Surma

## Using Real-Time Physiologic Data to Predict Outcomes in Critically-Ill Patients in the Pediatric ICU

Conventional cardiovascular monitoring may not provide a complete measure of tissue hypoxia, and there is always the possibility that standard treatments that support oxygen delivery, like blood transfusions, may fail to restore tissue oxygenation. By obtaining accurate oxygen saturation levels, clinicians can decide the best method for treatment and help improve patient care. Near-infrared spectroscopy (NIRS) provides a non-invasive, detailed monitoring of tissue oxygenation in an abundance of clinical scenarios, but it is commonly used to measure brain oxygen levels during and after pediatric cardiac surgery. This summer, I had the opportunity to explore the use of NIRS in the pediatric cardiac ICU (PICU). The lab I was a part of worked on a retrospective analysis that aimed to assess changes in cerebral and somatic oxygenation measured by NIRS following a red blood cell (RBC) transfusion in pediatric post-operative cardiac patients. Through analyzing tissue oxygenation data before and after RBC transfusion, one can evaluate the impact of the intervention and improve clinical decision-making for the blood transfusion decisions after cardiac surgery. The ultimate goal is to define effective treatment criterion so that children spend less time in the PICU and more time playing outside with healthy hearts. In addition to attending biweekly lab meetings, I organized some of the lab's systematic reviews for a new definition of multiple organ dysfunction in children. Throughout these projects and compelling conversations Johns Hopkins faculty, my zeal and knowledge for science and medicine grew in unexpected ways during quarantine.

**SY'KERIA D. GARRISON**
Mentor: Gregory V. Carr

## Degraded Stimuli Impair Performance in a Rodent Continuous Performance Test

Schizophrenia is a complex psychiatric disorder characterized by so-called positive (hallucinations and delusions), negative (apathy and emotional withdrawal), and cognitive (attention and memory deficits) symptoms. Approximately 20 million people worldwide have schizophrenia. Currently approved therapies improve positive symptoms, but are not effective against negative or cognitive symptoms, so there is a need for novel therapeutics that address these residual symptoms. Continuous performance tests (CPTs) are used to measure sustained attention in clinical settings. Patients with schizophrenia demonstrate impaired performance in CPTs. The schizophrenia-related impairment is exacerbated when low-contrast (degraded) stimuli are used. Here, we developed a mouse model of a degraded-stimulus CPT that allowed us to measure performance in response to different levels of degradation. As with the human versions of this task, we show that mice perform more poorly on degraded- stimulus CPTs than they do on high-contrast versions of the task. In this study we measured sensitivity (d') in addition to hit rate, false alarm rate, and response latency. These data show that d' and hit rate decrease while false alarm and response latency increase as the level of stimulus degradation increases. The observed decrease in perceptual sensitivity, increase in mistakes, and decrease in processing speed are evidence that our mouse version of the degraded stimulus CPT may serve as a preclinical model for human CPTs due to the similar effects of stimulus degradation. Our results suggest that the rodent CPT may be a useful translational platform for identifying neural mechanisms underlying schizophrenia-related attentional deficits and potential therapeutics.

**HANA-JOY HANKS**
Mentor: Caren Freel-Meyers

## Design of Hydrophobic INH-conjugates for Long-Acting Tuberculosis Treatment

Tuberculosis (TB) impacts about one quarter of the world's population and is one of the leading causes of death globally. Typical therapeutic treatment involves frequent administration of antimycobacterial drugs at high dosage for an extended period that requires high adherence. The establishment of long-acting (LA) medicines would allow for improved treatment adherence and clinical outcomes. Isoniazid (INH) is a commonly used drug in treating TB but is not a good candidate for LA applications due to high solubility in water and fast elimination from the body. Reducing water solubility of INH through chemical conjugation can potentially lead to INH conjugates that have slow release properties, allowing less frequent administration and improved patient adherence. This project focuses on the development of a strategy to increase hydrophobicity of INH by conjugation of hydrophobic substituents at the pyridyl nitrogen. We discuss preliminary results on the INH conjugation strategy for LA INH.
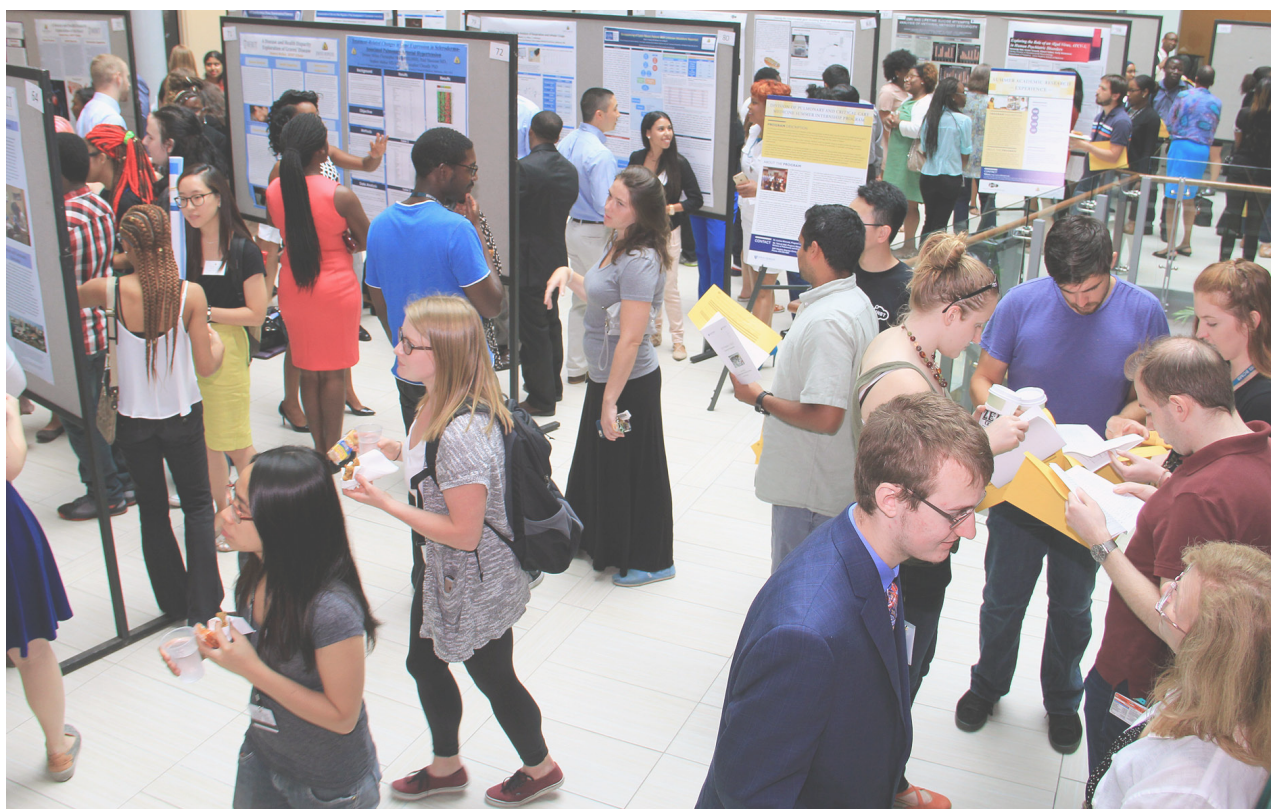
**NAOMI JOHNSON**
Mentor: Dr. Akira Sawa

## ENIGMA-TRS

ENIGMA (or Enhancing Neuro Imaging Genetic Meta-Analysis), one of the world's largest consortiums of brain imaging projects, is focused on large collections of clinical data to aid in research for over 1400 scientists across 50 working groups to increase the number of participants in their studies; thus, allowing for more statistically significant data. International collaborative projects like ENIGMA help to provide larger sample sizes, giving researchers the opportunity to obtain robust and reliable findings across different demographics.

Dr. Akira Sawa's lab is current leading an ENIGMA project that is in collaboration with 11 other institutions. The purpose of the ENIGMA-TRS (treatment resistant schizophrenia) is to focus on comparing treatment resistant versus non-treatment resistant patients to identify neuroimaging markers. Additionally, the project looks at comparing patients who use clozapine, those who do not use clozapine, and healthy controls. There are 11 institutions on the ENIGMA-TRS project, among which, five sites have been contributed datasets with clozapine usage information.

Researches showed that gender, ethnicity, handedness, and smoking could affect brain structures. Thus, it is important to analyze the demographic landscapes of study participants before studying the relationship between brain structural changes and clozapine usage

During my summer internship in Dr. Sawa's group, I learned about the process of clinical recruitment by attending the weekly recruitment group meetings. I participated in the ENIGMA-TRS project by cleaning and organizing the datasets, analyzing the demographic landscape of study participants from the five sites, and created tables and figures that will be useful for future analysis.

**MARIAH JORDAN**
Mentors: Kathryn Foti, Elizabeth Selvin

## Trends in physician recommend lifestyle modifications to control hypertension

The 2017 American College of Cardiology/American Heart Association (ACC/AHA) Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure lowers the definition of hypertension to allow for earlier detection and intervention. The 2017 ACC/AHA guideline minimally increases the proportion of US adults recommended for antihypertensive medication, granting physicians the opportunity to recommend lifestyle modifications at earlier stages. This study sought to examine trends across 2-year periods in physician recommended lifestyle modifications by sex and race/ethnicity in 3 age groups. We analyzed data from the 2011-2016 National Health and Nutrition Examination Survey (N=15927). Across all time periods, a larger proportion of younger women (ages 20-39 years) and middle aged women (ages 40-59 years) in comparison to younger and middle aged men received doctor recommendations to make lifestyle modifications. Additionally, differences in doctor recommended lifestyle modifications were least prevalent in older men and women (ages >60 years) across all time periods. Furthermore, across all time periods, a larger proportion of non-Hispanic blacks and Mexican Americans received doctor recommendations to make lifestyle modifications than non-Hispanic whites. Ongoing analysis examines trends in patient adherence to these recommendations. Our findings highlight opportunities to improve physician counseling regarding lifestyle modification overall and among specific population subgroups to reduce the risk of cardiovascular disease.

**SHARON KUNG**
Mentor: Dr. Elias Zambidis

## Naïve Human Induced Pluripotent Stem Cells for Regenerative Therapies

With the rapid advancement of regenerative medicine, researchers utilize Human Induced Pluripotent Stem Cells (hiPSC) to generate progenitor cells, precursors to fully differentiated cells, in efforts to treat a multitude of diseases such as ischemic blindness and Parkinson's disease. Dr. Zambidis' lab previously discovered that the reversion of hiPSCs to the naïve state produces naïve vascular progenitor cells that elevate revascularization in ischemic retina more effectively than progenitors derived from non-naïve hiPSCs. Naïve hiPSCs introduce a new model of stem cells that potentiate multi-lineage functionality by reducing the lineage-primed biases, epigenetic aberrations, and karyotypic instabilities of conventional hiPSCs, thereby, improving the efficacy of regenerative stem cell therapies. Although my summer experience was remote, I had the pleasure of learning more about the field of regenerative medicine by reviewing and presenting journal articles pertaining to Dr. Zambidis' lab's research.
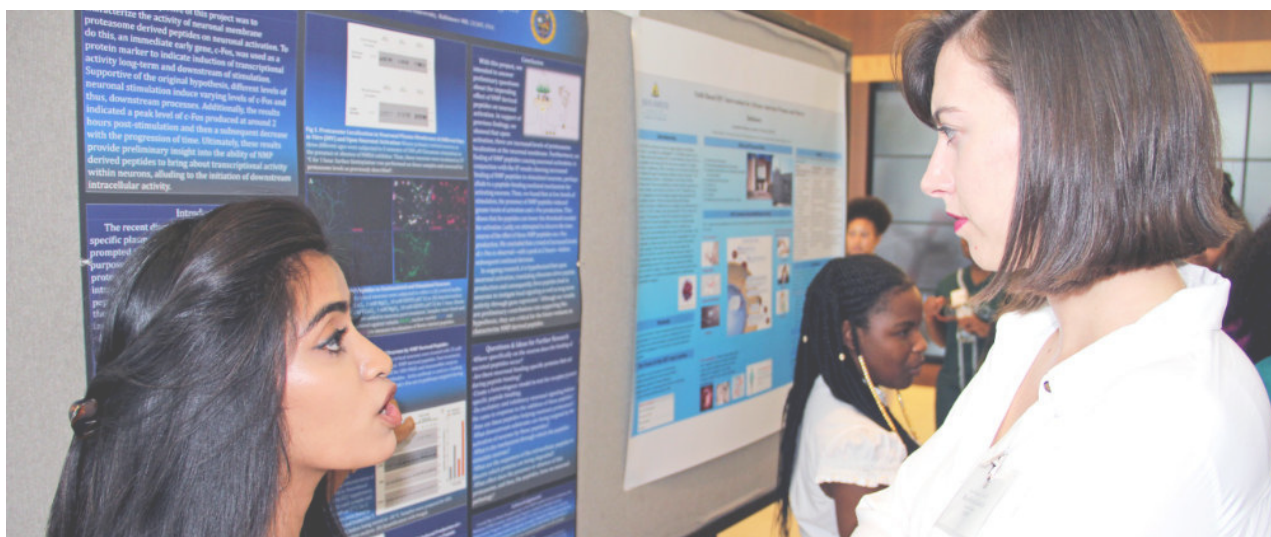
**KENA LEMU**
Mentor: Beza Woldemeskel, Joel N. Blankson

## Cellular Metabolism Effect on the death of HIV-1 Productively and Latently Infected CD4 T-cells

Introduction: HIV preferentially infects subsets of CD4 T-cells with high metabolic activity. Treatment of the cells with metabolic inhibitors to inhibit glycolysis over an extended amount of time has been shown to inhibit HIV replication. We aimed here to determine whether short term treatment with metabolic inhibitors (DON and 2DG) can lead to selective death of HIV productively infected CD4 T-cells. 6-diazo-5-oxo-l-norlecuine (DON) is a glutamine antagonist and 2-deoxy glucose (2-DG) is a competitive inhibitor of glycolysis.

Methods: CD4+ T cells were infected with either replication-competent HIV or GFP expressing pseudotyped HIV. A subset of cells were then activated and/or treated with metabolic inhibitors. Cell death was analyzed with Annexin V and the Zombie stain.

Results: In stimulated cells, a slightly higher percentage of apoptotic cells were observed with cells infected with the pseudotype virus when treated with 2DG compared to NT and higher percentage for both DON and 2DG and their combination when cells where infected with BAL virus and observed using Annexin V. No difference in cell death in cells treated with the inhibitors was detected by the Zombie stain. Metabolic inhibitors did not cause more apoptosis in cells that were not stimulated after infection. In contrast, more apoptosis was seen in cells treated with both metabolic inhibitors when the cells were stimulated after infection.

Conclusion: Metabolic inhibitors cause an increase in apoptosis of HIV infected cells following immune activation.

**AVERY MCNAMARA**
Mentor: Irving Reti

Electroconvulsive therapy (ECT) is one of the oldest and most effective therapies used to treat severe, intractable forms of mental illnesses. However, there has also been strong evidence in several case reports that document the safe and effective use of ECT for treating children and adolescents with autism spectrum disorders (ASD) who are suffering from devastating self-injurious behaviors (SIB). When traditional pharmacological, behavioral and combined therapies fail to suppress SIB, ECT is a viable option that can produce life-changing results for patients. While there are several cases that prove the effective use of ECT to treat catatonic youth with intellectual disabilities, few have addressed this unique subset of individuals with an ASD suffering from SIB. In order to develop and improve treatment options for patients, it is critical to understand how concomitant ECT variables (such as seizure length) contribute and correlate to the overall reduction of SIB post ECT treatment. The design of my study was a retrospective chart review of patients under the age of 18 with an ASD who have completed courses of ECT for severe SIB from 2006 to the present. The primary objective of my project was to assist in determining the correlation between seizure length induced by ECT and suppression of SIB in children and adolescents with ASD. As the adverse side effects of long-term ECT regimens are unknown at this time, the secondary objective of this study would be to use this data to optimize an ideal protocol of best practices or alternate treatments.
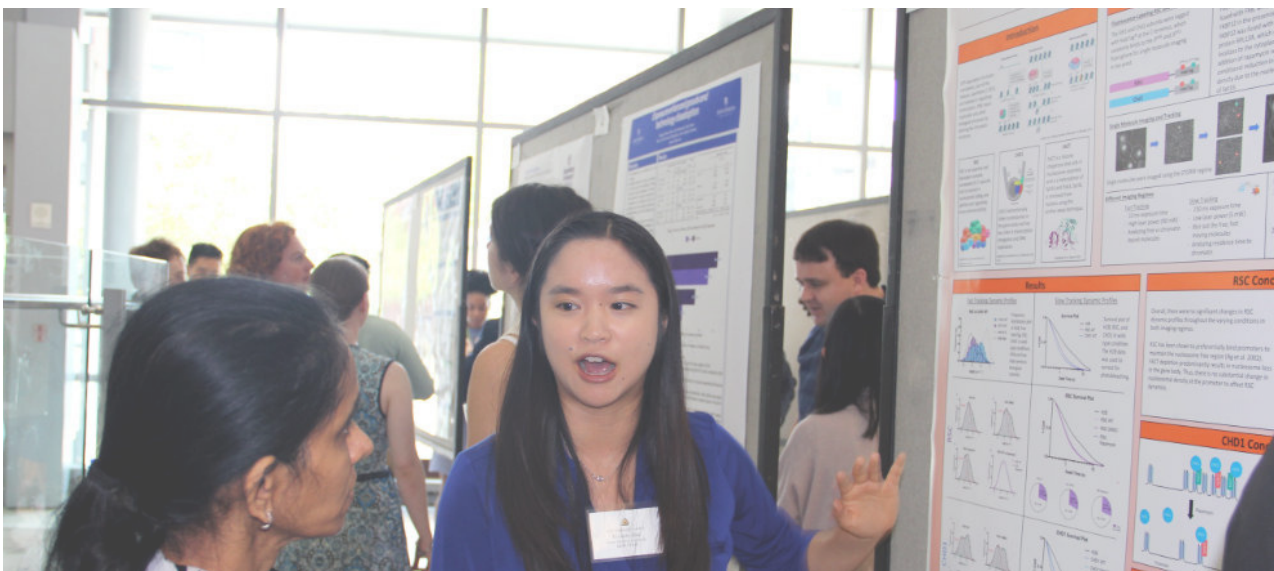
**YOLANDA SIMPSON**
Mentor: Dr. Namandjé Bumpus, Dr. Josh Yu

## Classification of metabolomic profiles implicated in COVID-19

Accompanying the rise of SARS-CoV-2, identifying methods to classify and diagnose the virus have become vital. Mass spectrometry is a technique that identifies metabolites from biological samples, producing metabolomic profiles that can be used to differentiate COVID-19 patients from control groups. In analyzing compiled metabolomics data from the MassIVE CoronaMassKB database correlated to the article, "Proteomic and Metabolic Characterization of COVID-19 Patient Sera," numerous metabolites were identified as potential biomarkers from the SARS-CoV-2 virus. For my research, I analyzed the differences in metabolite production among healthy, non-COVID-19, and COVID-19 patients. The use of a multivariate receiver operation characteristic (ROC) curve revealed that ten metabolites could be used as potential biomarkers to distinguish COVID-19 patients from healthy volunteers with an AUC of 0.997 (95% CI [0.968,1]);. The metabolites and accompanying FDR-adjusted p-values (q-values) are as followed: dibutyl sulfosuccinate (q=4.6E-65), beta-alanine (q = 2.5E-21), benzoate (q = 6.0E-27), 4-chlorobenzoic acid (q = 1.1E-16), S-carboxyethlycysteine (q = 5.8E-11), cytosine (q = 6.9E-12), N-palmitoyl-sphingosine d181/160 (q = 6.6E-13), 4-methoxyphenol sulfate (q = 2.6E-9), alpha-tocopherol (q = 1.4E-8), and o-cresol sulfate (q = 1.6E-9). A separate ROC curve identified ten metabolites useful in distinguishing COVID-19 and non-COVID-19 patients with an AUC of 0.951 (95% CI: 0.855-1):  phosphocholine (q=5.0E-10), cytosine (q=5.0E-7), cysteine sulfinic acid (q=1.1E-4), N-delta-acetylomithine (q=1.1E-6), N-formylmethionine (q=3.1E-5), AMP (q=3.6E-5), 2,3-dihydroxy-5-methylthio-5-pentenoate DMTPA (q=3.8E-4), 5-methyluridine ribothymidine (q=5.2E-5), cysteine (q=1.1E-4), and 7-hydroxycholesterol alpha or beta (q=9.9E-5). The identification of these biomarkers allows for increased confidence in the diagnosis of the virus, and holds implications in the development of drug therapies as we continue to monitor the COVID-19 pandemic.

**MELAT TAREKEGNE**
Mentor: Matthew Hurley

## Effect of the activity-based anorexia model on parvalbumin interneuron count and oxidative stress levels in adolescent female rats

Objective: Our lab has demonstrated animals in the activity-based Anorexia (ABA) paradigm show signs of increased oxidative stress. Previous studies have found that parvalbumin (PV) interneurons are particularly susceptible to oxidative stress due to their fast spiking nature. We set out to test whether the ABA model leads to a reduction in PV interneurons, and if these PV interneurons have higher amounts of oxidative stress.

Method: 10 adolescent female rats were exposed to activity-based anorexia conditions (ABA; 1.5HR chow/ad lib wheel until 25% weight loss) whereas 8 adolescent female rats were kept sedentary (SED; ad lib chow/locked wheel). After they hit maximum weight loss, the ABA animals were sacrificed via perfusion for later immunohistochemistry analysis of parvalbumin staining as well as 8-oxo-dG, which is an intracellular marker of oxidative stress. The 8 rats in the sedentary group were sacrificed at the same age as the ABA animals. The number of parvalbumin (PV) interneurons in the medial prefrontal cortex (mPFC) were counted using Image J software. Finally we compared 8-oxo-dG intensity in PV positive cells in SED vs. ABA mPFC via corrected total cell florescence.

Results: When analyzing a 10x image of the mPFC we found that ABA animals have significantly less PV cells, compared to sedentary control (t=3.889; df=16; p=0.0013). Additionally, we found 8-oxo-dG density in PV cells was significantly higher compared to the sedentary group (t=3.732; df=16; *p=0.0018).

Discussion: A lower density of PV neurons might suggest that this would result in increased asynchronous activity in the cortex. Previous studies have implicated asynchronous cortical firing in the production of anhedonia.

**JONATHAN TUSCANO**
Mentor: Dr. Laura Ensign

## Melanin-binding: a mechanism for sustained ophthalmic drug release

One problem in ophthalmic medicine is sustained drug release in the eye.  Injectables have short half-lives and are easily broken down by ocular metabolic enzymes.  A solution to this problem leverages the natural physiology of the eye, using melanin as a drug "depot."  Melanin is a molecule synthesized within melanosomes-- organelles found in cells of the uveal tract, retinal pigmented epithelium, and choroid tissues. One of the primary functions of melanin is to prevent DNA damage from light exposure.  Melanin is an excellent candidate for drug staging due to its low turnover rate.  Melanin-binding is a phenomenon that researchers in the Ensign lab are using to increase half-life of ophthalmic drugs for sustained drug release.  Melanin-binding is accomplished by conjugating a drug with a molecule that possesses ideal characteristics for melanin-binding (basic ionization category, logD ⬚ 2.0, basic pKa 9.38 ⬚ x ⬚ 5.71, number of aromatic rings ⬚ 3).  In this study, a molecule was synthesized possessing these several characteristics.  Melanin-binding affinity and cell-entering capacity were then tested via assays specific to each (using melanin from Sepia officinalis).  Efficacy was then measured through 'fraction unbound percentage' (fu%); a low percentage (5% ⬚ fu) implying an effective melanin-binder.  The molecule was found to be in the 'very high' binding category (1% ⬚ fu).  Implications of these findings could mean decreased injection frequency, due to increased half-life of drugs, for patients suffering from various ocular diseases (injection frequency decreasing from every 4-6 weeks to semiannually).

**HANNAH N. WILKINS**
Mentors: Francesco R. Simonetti, Janet D. Siliciano, and Robert F. Siliciano

## Characterization of proviruses with 5 Prime Small Deletions: Implications for HIV-1 Persistence

The development of antiretroviral therapy (ART), which suppresses HIV-1 replication and prevents disease progression, has significantly improved HIV-associated morbidity and mortality.1 Nevertheless, the presence of latently infected CD4+ T cells remains the main barrier to a cure for HIV1.2 The latent reservoir is composed of replication-competent HIV-1 proviruses; however, approximately 90% of all infected cells carry defective proviruses.3 These proviruses are not infectious due to genetic defects, such as internal deletions and hypermutation but retain the potential to express viral transcripts and proteins, complicating the study of HIV-1 persistence and contributing to chronic immune activation.  We created a comprehensive data set of 215 HIV-1 proviral sequences with 5' small deletions, which affect cis-acting elements that regulate key steps in the HIV-1 replicative cycle. These deletions usually involve the dimerization initiation signal, the major splice donor (MSD) site, the packaging signal, and Gag translation start codon. Interestingly, defects in the MSD can be rescued by alternative splicing sites.4 We will conduct a meta-analysis of proviral sequences to investigate the impact of these defects on HIV-1 expression. In addition, we will study the mechanisms leading to these deletions. We hypothesize that the HIV-1 genomic RNA stem loops, typical of this region, cause reverse transcriptase stalling and slippage, resulting in small deletions.  Our study will provide a better understanding of retroviral biology and the interplay between proviral defects, latency, and the persistence of infected cells. Moreover, our results will improve the design of assays used to quantify the reservoir in HIV-1 remission studies.

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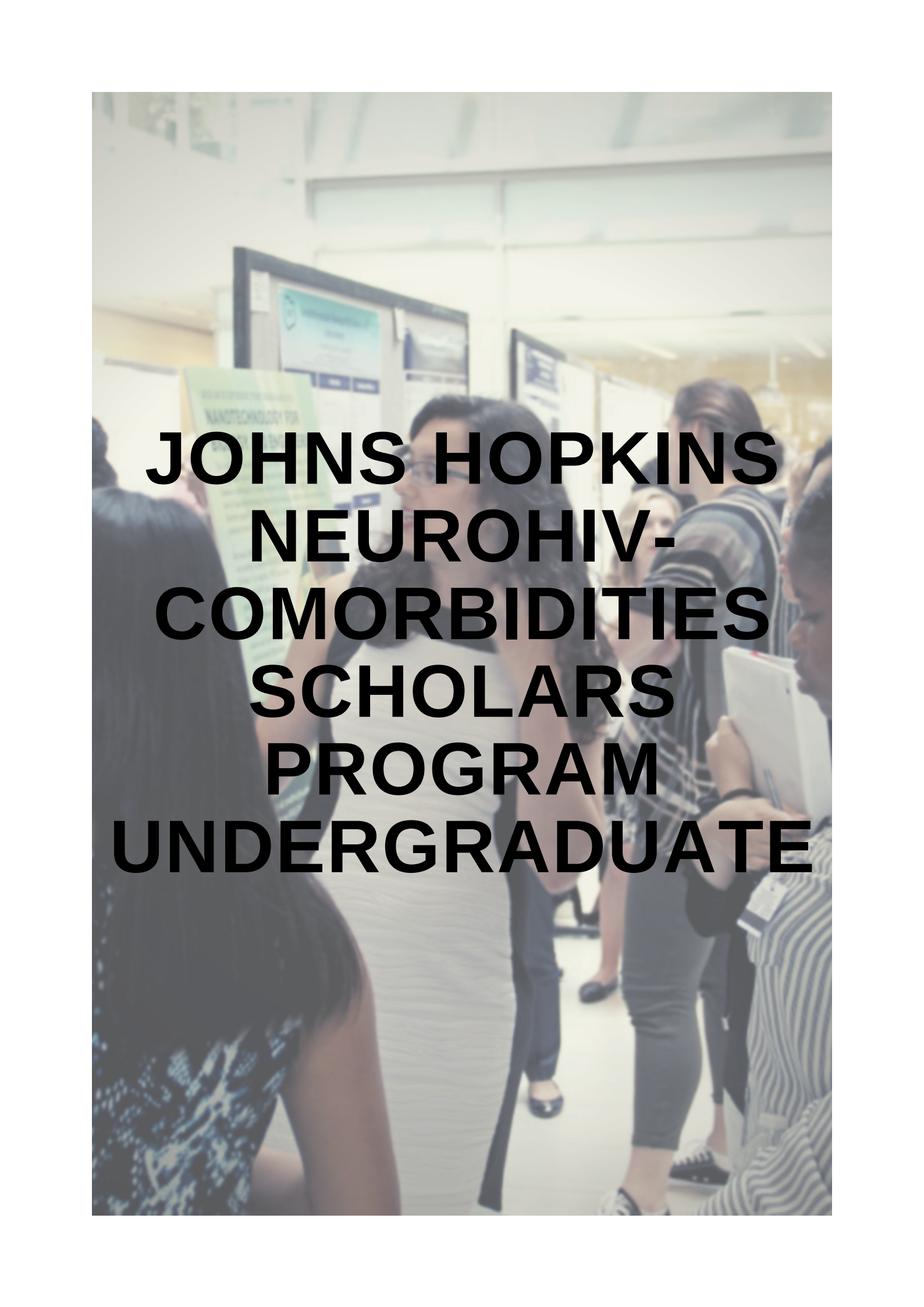
**REBECCA ZASLOFF**
Mentor: Dr. Luigi Marchionni

## Characterizing Gene Expression Programs of Neo-adjuvant Chemotherapy Resistance in Breast Cancer

Neoadjuvant chemotherapy is a type of treatment for breast cancer that is administered before the surgical removal of a tumor in order to shrink its size and safely proceed with surgery. Most tumors respond to neoadjuvant chemotherapy, however in some patients, tumors are resistant to treatment and do not shrink. For these patients, there is no benefit of postponing surgery until after chemotherapy.  In order to better approach treatment plans for patients with breast cancer, it is therefore important to identify the genes and pathways that drive chemotherapy resistance. This, in turn, will help eradicate resistance to neoadjuvant chemotherapy, a critical unmet clinical need.

For my project, I used the statistical programming language R and Bioconductor software tools to perform gene expression analysis in a breast cancer dataset obtained from the Gene Expression Omnibus database. Using a generalized linear model approach, I was able to identify genes that are differentially regulated among patients responsive and resistant to neoadjuvant chemotherapy. I further characterized the set of differentially expressed genes using Gene Set Enrichment Analysis (GSEA), in order to determine which biological groups of genes are dysregulated, and identify specific pathways or biological processes that are involved in chemotherapy resistance.

The identified genes and pathways can be used as candidate biomarkers to develop clinical decision rules and prediction algorithms to predict how breast cancer patients will respond to neoadjuvant chemotherapy and hence determine a proper treatment plan. Collectively, these results can also contribute to the discovery and implementation of alternative treatment methods.

# JOHNS HOPKINS NEUROHIV-COMORBIDITIES SCHOLARS PROGRAM UNDERGRADUATE

**EDIAN CUEVAS**

## Elevated intracellular Calcium in Schwann cells directly impact neurons may contribute to HIV-induced peripheral neuropathy

Painful peripheral neuropathy is a common HIV-induced complication whose cause remains unknown.  Prior publications have shown that Schwann cell lysosomal exocytosis of ATP into the extracellular space contributes to neuropathic pain in patients living with HIV. ATP is released by Schwann cells either by hemichannels or lysosomal exocytosis, but it has not been established which of the two has a greater contribution to ATP release in HIV patients. HIV-gp120 appears to be the primary cause of neurotoxicity. It promotes calcium-dependent lysosomal ATP exocytosis in Schwann cells, which may lead to ATP-activation of lysosomal P2X4 receptors on Schwann cells and DRG neurons. Activation of these receptors increases intracellular $Ca^{2+}$ levels that impact the function of Schwann cells and generate cytosolic reactive oxygen species in DRG neurons. This suggests communication between Schwann cells and neurons, but does ATP from Schwann cells or elevated intracellular $Ca^{2+}$ in Schwann cells directly impact neurons? We will evaluate these 2 questions in Schwann cell and DRG neuron monocultures. Using calcium chelators, P2X4 inhibitors, and techniques to isolate ATP-containing lysosomes from Schwann cell culture media, we will evaluate the relationship between gp120-induced calcium release from ER and Schwann cell P2X4-induced $Ca^{2+}$ flux interfering with DRG neurons. Conducting these experiments, we expect to see whether the increase in Schwann cell calcium levels and lysosomal ATP release directly impact neurons. Through the experiments in HIV-gp120 cell culture, we hope to better identify the critical cell biological pathways that may contribute to HIV-induced peripheral neuropathy. These studies may ultimately inform further experiments in animals to test these hypotheses in vivo. Although there are inhibitors that silence mediates purinergic receptors, following ATP, $Ca^{2+}$ signal elimination, there are no known related mechanisms for ER, purinergic receptors, and the possibility of these having a role in mediating pain.

KEYWORDS
gp-120, endoplasmic reticulum, extracellular calcium, Schwann cells, DRG neurons, P2X4R.

# JOHNS HOPKINS NEUROSCIENCE SCHOLARS PROGRAM UNDERGRADUATE STUDENT

**ALEXANDRA WONG**

## The Effect of Aging and Memory Impairment on Experience-Dependent Plasticity of Hippocampal Place Cells

Spatial memory is largely controlled by the hippocampus. A significant proportion of hippocampal pyramidal cells increase their firing rates in specific spatial locations in its exterior environment. These cells are termed place cells, and the spatial locations they become active in are their corresponding place fields. It is thought that Hebbian strengthening of synapses between hippocampal neurons with overlapping place fields underlies the storage of specific route information crucial for spatial memory (Blum & Abbott, 1995).

Previous experimental work on hippocampal CA1 and CA3 neurons' place field properties confirmed this hypothesis that temporally asymmetric Hebbian long-term potentiation enables sequence learning in the hippocampus. The firing rate distribution of place cells exhibited experience-dependent changes. Specifically, with repeated traversal of a closed track by the same route, rat hippocampal CA1 and CA3 neurons expanded their place fields and developed negative skewness in their firing rate distributions, resulting in a shift in their centers of mass in the direction opposite to the direction of the route (Mehta et al.,1997; Mehta et al., 2000; Lee et al., 2004).

In our current study, we are investigating how these field properties of hippocampal CA3 place cells differ in old rats, both memory-impaired and unimpaired, when compared to young rats. Implications of this study may outline an underlying aspect of memory impairment in the hippocampus, potentially including the effects of Alzheimer's disease.

# SCHOLARSHIP
## RECIPIENTS

**Shantika Bhat**
Summer Academic Research Experience (SARE)

**Ariyan Sajid**
Summer Academic Research Experience (SARE)

**Kristiana Smith**
Summer Academic Research Experience (SARE)

**Adriana Alarcon**
Centro SOL

**Maydeli Avila**
Centro SOL

**Jacquelyn Amaya**
Centro SOL

"Though the BRBT/SARE Internship has gone virtual for this summer, they are doing a GREAT job of presenting an online version of the program and I am fortunate enough to be exposed to the various aspects of this internship such as mathematics, reading, writing, lectures, labs, mentorship, and college readiness. Yet, I mostly enjoy the labs, reading, and college readiness aspects because, collectively, they have been solidifying my foundation of pursuing a lifelong career in the medical field."
**~Elizabeth Olu-Ajayi**

"Interning at Johns Hopkins University School of Medicine PCCM Program has been a great opportunity to develop and expand my knowledge while working towards something I deeply care about—the advancement of medicine. It has been inspiring to engage with fellow scientists who are driven and passionate about both clinical and research-based medicine. The faculty at Hopkins truly values their interns, and the work I have been given has been dynamic and meaningful. I would highly recommend anyone interested in pulmonary and critical care medicine to check out Hopkins PCCM Program."
**~Pedro X. Medina**

"Through the virtual summer internship program, I learned valuable research skills like how to read articles, process data, and create experiments. Arguably more important, however, were the contributions this program made to my understanding of health equity and ethics in research. I leave this program both with the skills and ethics to become a well-rounded research leader."
**~Madison Bates**

"My experience this summer was absolutely incredible. I learned so much about what it means to be a physician scientist and this program has only increased my hopes of becoming one soon. Though the virtual experience was not what anyone wanted, it was so much better than what I think anyone would have expected from a virtual internship coming into the summer."
**~Miguel Iglesias**

# Testimonials

"This summer "at" Johns Hopkins has been one of the most invigorating experiences of my academic career. The division of Pulmonary and Critical Care Medicine has been extremely welcoming, and I feel I have learned a wealth of information that can be applied to my career and my goals. This summer program has taken me one step closer towards achieving my aspiration of working with underrepresented minorities through healthcare, and I will be forever grateful for this amazing experience."
**~Ian Isaac Reyes**

"This summer was above and beyond what I expected from a virtual internship. It has taught me so much and made me a more confident student scientist."
**~Jailyn Smith**

"My summer experience has been one filled with inspiration and positive connections. From the very first day, Dr. Shimoda and Dr. Damarla have created a welcoming environment in which we were able to learn a multitude of research methods and techniques. On top of that, as a cohort we were able to connect despite being limited to a virtual platform, and foster relationships that may very well last a lifetime."
**~Abidemi Aregbe**

"Before the start of the Leadership Alliance Summer Internship Program, I would have never imagined how impactful our zoom meetings would be. I feel fortunate to have had the opportunity to learn from scientists, physicians, and like-minded peers through Johns Hopkins."
**~Isabel Alcazar**

"This summer "at" Johns Hopkins has been one of the most invigorating experiences of my academic career. The division of Pulmonary and Critical Care Medicine has been extremely welcoming, and I feel I have learned a wealth of information that can be applied to my career and my goals. This summer program has taken me one step closer towards achieving my aspiration of working with underrepresented minorities through healthcare, and I will be forever grateful for this amazing experience."
**~Ian Isaac Reyes**



"I am so grateful that I had an opportunity to participate in this Pulmonary and Critical Care Medicine Internship at Johns Hopkins this Summer. I especially enjoyed working with the students and mentors of my research team and hearing from several professionals about their work. I really appreciate everything that was put into creating this amazing experience despite it being online. Thank you all!"
**~Brittney Tiffault**



"Although unable to continue with an in-person experience due to COVID-19, this opportunity has allowed me to gain a greater insight into clinical approaches, research ethics, and the importance of diversity in healthcare"
**~Autumn Brunson**



"Being accepted into the "Division of Pulmonary & Critical Care Medicine Summer Internship Program" has been one my greatest and best experiences in my life, yet interacting with doctors and students from all sort of backgrounds at Johns Hopkins has given me the confidence to believe that someone like me, a Hispanic pre-medical student, can contribute to their team while attending one of the greatest universities in the world."
**~Julman Bottino**

"I'm beyond grateful that I was able to participate in the internship, despite being virtual because it was still extremely beneficial. I felt connected and supported by my cohort, directors and the faculty at Johns Hopkins. There was a lot for me to take away academically and personally!"
**~Kayla Elder**

"I have learned so much from this summer program! Although it was virtual, I was still given a sense of community and felt connected to my fellow peers who I can know call friends."
**~Kelsey Evans**

"Participating in the Pulmonary and Critical Care Medicine Virtual Summer Internship Program has been the highlight this summer for me. This program repeatedly challenged my understanding of the work done by physicians and physician-scientists. It has been an honor learning from our phenomenal mentors and guest speakers alongside my fellow interns."
**~Cady Kurtz-Miott**

"The Pulmonary and Critical Care Medicine Internship has completely altered my perspective of medicine, unveiling to me a practice that is scientific, patient-oriented, and community-based. I have grown professionally by learning and implementing knowledge about a variety of topics ranging from those in basic science research to clinical research, while simultaneously gaining fundamental skills in ethics, community engagement, and research presentations."
**~Charlene Mansour**

"Despite the current conditions amongst the COVID-19 pandemic, SARE has managed to amaze and provide an insightful experience. What I appreciate most is the networking: being able to meet and connect with professionals in the research setting is an honor, and all the mentors have been able to provide guidance and advice regarding my academic career."
**~Ariyan Sajid**



"This once in a lifetime opportunity allowed me to do what I love throughout the summer. Not only has this program refined my skills as a scientist, but has given me the tools to grow as an individual through the exposure of the participants' and mentors' perspectives"
**~Denzel Edwards**
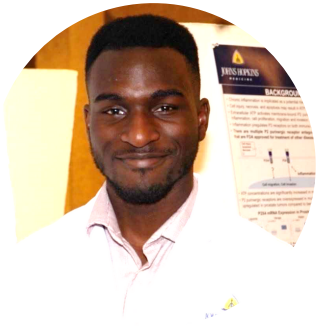


"It has been a fantastic opportunity being a part of the Johns Hopkins Neuroscience Scholars Program for the second summer running! I was able to realize my potential in the field of neuroscience research and medicine and I was continuously spurred on by caring, supportive, and driven faculty in multiple facets of the career field. This was truly a catapult forward for my personal and professional growth!"
**~Dami Adeshina**



"I am immensely blessed to have been a part of the Johns Hopkins Neuroscience Scholars Program this summer. This summer I have had the amazing opportunity to learn from the tutelage of multiple excellent scientists. Likewise, I can sincerely say that I have formed lifelong friendships with future world renowned neuroscientists. I am very thankful for the members of the program (from fellow interns, to the program director and program administrator) who have all been my support system. Around them, I feel like I matter, like I am important and that most of all that I belong!"
**~Ayotimofe Idowu**

# JOHNS HOPKINS
# C.A.R.E.S PLANNING TEAM
## Thanks You!

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