

# Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

## Online Proceedings

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### SESSION 1B

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#### TECHNIQUES FOR IMPROVING QUALITY OF MEDICAL CARE

Session Moderator: *Eric Seibel, Mechanical Engineering*  
**MGH 228**

12:30 PM to 2:15 PM

\* Note: Titles in order of presentation.

##### **Physician Assessment of Blinded Adverse Events in Randomized Controlled Trials in Cystic Fibrosis**

*Madeline (Maddy) Wessels, Senior, Computer Science*

*UW Honors Program, Undergraduate Research*

*Conference Travel Awardee*

*Mentor: Christopher Goss, Medicine and Pediatrics*

Adverse Events (AEs) are detrimental medical incidents in a research participant that may or may not be related to the investigational agent. During clinical trials, physicians are required to document attribution of AEs with limited guidance regarding how to assign attribution. The objective of this study was to determine the accuracy of physician based attributions for AEs occurring in cystic fibrosis (CF) patients participating in blinded randomized controlled trials (RCTs). This retrospective study pooled clinical trial data from 4 CF RCTs; all participants who experienced  $\geq 1$  AE were included. A repeated measures logistic regression model using generalized estimating equations and adjusted for baseline demographic variables (gender, age, CF genotype), comorbidities, and lung function (forced expiratory volume in one second; FEV1). The primary predictor of interest was receipt of study drug versus placebo. The primary outcome of interest was physicians' determination of the AE as related to study drug. Study patients were young with mild lung disease. Receipt of study drug was not significantly associated with the likelihood a physician would deem an AE to be related to study drug. However, we found significant associations between age, gender, and FEV1 and our outcome of interest—presence of an AE felt by a physician to be related to study drug. These findings suggest a biased assessment of physician attribution. Physician assessment of relatedness in RCT's is a key requirement per the Food and Drug Administration (FDA). We found no significant association between AEs coded as related to study drug and actual study drug receipt. Interestingly, we found other associations implying an

intrinsic bias in physician assessment based on age, gender and disease severity. Further research may clarify whether changes are needed to current FDA guidelines.

### POSTER SESSION 2

**Commons East, Easel 53**

1:00 PM to 2:30 PM

##### **Advancing State-of-the-Art UAS Networking and Communication with Software Defined Radios**

*Connor Joseph (Connor) Kafka, Sophomore, Electrical Engineering*

*Zachary Terryl (Zach) Williams, Junior, Aeronautics & Astronautics*

*Karine C, Junior, Pre Engineering*

*Mentor: Christopher Lum, Aeronautics & Astronautics*

This project focuses on adding unique telemetry and communication capability to one of the largest and fastest growing areas in the Washington State aerospace industry: Unmanned Aerial Systems (UAS). These systems have the potential to revolutionize a wide variety of commercial applications such as precision agriculture, disaster management, mapping, and ecological/biological monitoring and represents a \$13.6 billion civilian market. One of the main challenges for UAS integration is to provide reliable and effective guarantees for safe operation that in turn requires high-performance and flexible control/navigation of the aircraft and reliable transmission modes from air to a ground control station or operator. For example, a typical commercially available UAV will have 3 distinct sensor-processing-radio chains, one each for onboard camera, one for data telemetry (navigation and strategic command) and one for primary command & control data. This effort fundamentally seeks to mature ongoing work at UW and will allow for greater communication bandwidth, enhanced flexibility, and levels of control between the UAS and GCS and achieve the required situational awareness as mandated for UAS operations. The outcome of this project will be a modular, encapsulated radio system that can be used to combine the myriad data links between a UAS and the GCS into a single, robust, and reconfigurable link. The link quality will be tested using a bladeRF software defined radio paired with a student built, Pixhawk based octocopter. Several flights tests will be conducted by students using custom built software which will measure the strength of the UAV based link in various environments. This project

encapsulates the construction of the octocopter, the build of the software defined radio system, and flight testing. A publicly accessible link quality database will be populated with flight test data in order to encourage further development of software defined based communication links.

## POSTER SESSION 2

Commons West, Easel 17

1:00 PM to 2:30 PM

### Polycyclic Aromatic Hydrocarbon Metabolites in Kenyan HIV-1 Infected Children

*Niloufar Ghodsian, Senior, Environmental Health*

*Mentor: Christopher Simpson, Environmental & Occupational Health Sciences*

In Kenyan HIV-1 infected children, it is likely that exposure to household indoor air pollution (HAP) increases susceptibility to respiratory illness, cancer, growth failure, and compromised cognitive abilities. Kenyan families usually live in one-room houses and use wood or charcoal cook stoves indoors. Smoke from burning of wood and charcoal contains large quantities of polycyclic aromatic hydrocarbons (PAHs) which are among the many components of incomplete combustion. Many PAHs are carcinogens that undergo metabolism and are excreted in urine. In order to assess children's exposure to wood and charcoal smoke, single spot urine samples were collected from 100 subjects: 50 recently diagnosed HIV-1 infected children, age-matched healthy HIV uninfected children, and their mothers. Urine samples were hydrolyzed by treatment with glucuronidase enzyme and cleaned up with solid phase extraction. High-performance liquid chromatography with fluorescence detection was used to analyze the samples for PAH metabolites. We anticipate that urinary hydroxyl PAH metabolite concentrations will be high in these cohorts of HIV-1 infected and healthy children reflecting the exposure to HAP by use of wood and charcoal for cooking. Findings of this research will help to understand the pathogenesis of cancer and respiratory diseases in HIV-1 infected children, healthy children, and their mothers.

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## SESSION 2F

### POLITICS AND CULTURE

*Session Moderator: John Wilkerson, Political Science*

**MGH 242**

3:30 PM to 5:15 PM

\* Note: Titles in order of presentation.

### The Longitudinal Effect of Defined Contribution Pension Plans on Employees in Public Sectors

*Judy Zhuang, Senior, Economics, Mathematics*

*UW Honors Program*

*Mentor: Christopher Anderson, Aquatic and Fishery Sciences*

*Mentor: Rachel Heath, Economics*

Many scholars have constantly claimed that a shift from defined benefit plans to defined contribution plans has been the wrong course of action in policy and it has brought direr effect to the economy. Economists have argued that defined contribution plans are generating inefficiency pension income for employees in the private sectors, creating further cost burden for taxpayers and discouraging employees to stay at a job. While most observers are accepting the current situation by sticking to the traditional defined benefit plans, there are significant indicators in which the shift to defined contribution plans is inevitable. Economic shocks such as financial crisis, new health policy like Affordable Care Act and Congress abolishment of the Aid to Families with Dependent Children federal assistance program have changed the tides. They have brought a great deal of attention on how defined contribution pension plans can shape agents' behavior in the labor market. Using datasets from the Survey of Income and Program Participation (SIPP) Synthetic Beta file and the National Quarterly Workforce Indicators, this paper examines the proposition that defined contribution plans motivate newly hired workers to stay at a job for a much longer period and gain higher weeks at pay without federal assistance programs taken place. This occurs particularly for male employees in public sectors. Regression analysis (OLS and logistic) demonstrates that workers enrolled in defined contribution pension plans have increasing personal level annual earnings taxed under FICA, higher probability in having employer-based health insurance and a larger family size in their individual households. Furthermore, this paper attempts to explain whether defined contribution plans have transitory or permeant effect on workers' wellbeing during economic shocks using unit root test to determine whether there exists a stochastic trend. Keywords: defined contribution pension plans, labor market, individual households, workers

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## SESSION 2G

### THE DYNAMICS OF CULTURE AND SPACE

*Session Moderator: Branden Born, Urban Design and Planning*

**MGH 248**

3:30 PM to 5:15 PM

\* Note: Titles in order of presentation.

### **Community Development through Freedom of Space: Public Spaces and Cultural Identities**

*Ariel Delos Santos, Senior, Aquatic & Fishery Sciences,  
Community, Environment, & Planning  
Mentor: Christopher Campbell, Urban Design And  
Planning Group*

Cultural festivals provide the opportunity to share and celebrate ideas, values, art, food, etc. from the heritage of other homelands. Aside from other smaller gatherings, these mass public festivities are typically held only once a year. With such a limited window for this type of cultural sharing, it is ideal that people of the represented community share fully their experiences of their culture and have the accommodating infrastructure to do so to increase cultural competency. Creating inclusionary spaces that allow cultural expression and celebration is termed cultural placemaking. After reviewing issues in *Journal of Planning Education and Research* from 2017-2010 I discovered that cultural placemaking was well intentioned but was not well reported or practiced. This is an issue when communities are projected to increase in density and in diversity. It is important for planners and city officials to know the significance of public spaces that allow for cultural expression in order to increase community development and cohesion as communities continue to grow. Through literature review, attending several festivals in Seattle, and interviews of students and festival participants, cultural festivals can provide a deeper understanding of culture instead of perpetuating stereotypes. The purpose of this project is to reintroduce the significance of cultural festivals to planners and city officials in the form of a white paper that also provides some suggestions to help local festival coordinators increase local participation, community support and create meaningful experiences for both visitors and people with cultural heritage.

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## **SESSION 2H**

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### **SUPPORTING STUDENT GROWTH FROM HIGH SCHOOL THROUGH THE UNIVERSITY**

*Session Moderator: Walter Andrews, Near Eastern  
Languages and Civilization*

**MGH 251**

*3:30 PM to 5:15 PM*

\* Note: Titles in order of presentation.

### **Recommendations for Varsity Esports: Supporting a New Generation of High School Athlete**

*Rahul Devanarayanan, Senior, Community, Environment, &  
Planning  
Mentor: Christopher Campbell, Urban Design And  
Planning Group*

Over the past ten years, esports, or competitive gaming, has come to the forefront of youth entertainment. In 2016, global awareness of esports surpassed 1 billion people. The largest segments of this population are college-age (18-25 years) and middle/high school-age (12-18 years). While significant activity is being undertaken by both universities and collegiate athletic conferences to develop varsity programs that structure the experience and growth of esports players, such efforts have not yet been made in high schools. My research clearly outlines the developmental impacts to students of varsity esports programs at the high school level. Based on the finding that such positive impacts scale directly with an administration's support for the club, my paper provides recommendations on how administrators and teachers can support esports programs, even in the common case where esports is a foreign concept to staff. I draw on: 1) an extensive literature review synthesizing secondary research on the effects of participating in high school esports and 'games in the classroom' curricula, 2) programmatic recommendations based on analyses of similar extracurricular and youth development programs, and 3) observations and interviews with existing high school esports communities. The end goal of my research is to make high school esports a more productive developmental experience for high school students by de-stigmatizing and structuring participation. In addition, I highlight opportunities for further research into the mechanics and effects of high school esports programs.

## **POSTER SESSION 4**

**MGH 241, Easel 137**

*4:00 PM to 6:00 PM*

### **Laying the Foundations for Protein Drug Design: A Thermophilic SUMO Protease System to Improve Heterologous Protein Expression**

*Kara Lau, Senior, Biology (Molecular, Cellular &  
Developmental)*

*Mary Gates Scholar*

*Mentor: Christopher Bahl, Biochemistry*

The forefront of modern medical research involves decoding the biological pathways that make disease transmission and perpetuation possible. Protein-based site-specific affinity reagents could allow us to antagonize harmful molecular interactions employed by pathogens, disrupt their toxic effects, and develop cutting-edge treatments. Consequently, the ability to express and purify rationally-designed proteins is the key to assessing their structure and function. To increase solubility and stability during recombinant expression, a genetic fusion to a small-ubiquitin-like-modifier (SUMO) is commonly used. The highly-specific SUMO protease is then used to cleave the SUMO fusion, leaving a completely intact and unmodified protein-of-interest. The current protease used originates from *Saccharomyces cerevisiae*. Known as Ulp1,

the instability of this enzyme due to thermosensitivity and solvent-exposed hydrophobicity presents considerable limitations and can result in incomplete digestion of SUMO-tagged constructs. We present two approaches to mitigate these complications. First, we have discovered a homologous protease with a conserved catalytic site in the thermophilic eukaryote *Chaetomium thermophilum*. Second, using the Baker Lab's pioneering computational design program, Rosetta, we have exchanged the hydrophobic surface residues of Ulp1 with hydrophilic side chains with the aim of improving stability in aqueous solution. We have characterized the kinetic function of these protease variants by monitoring digest efficacy through gel-based assays. Effectively, the improved proteases can equip the scientific community with a powerful new tool to facilitate protein-based drug design research.

## POSTER SESSION 4

MGH 241, Easel 138

4:00 PM to 6:00 PM

### Investigating Small Ubiquitin-Like Modifier Systems

Jaylee Michelle (JayLee) Morgan, Senior, Biology

(Molecular, Cellular & Developmental)

Mentor: Christopher Bahl, Biochemistry

Small Ubiquitin-like Modifier, SUMO for short, is a protein involved in cellular regulation which can also be used as a biochemistry tool to express difficult-to-express proteins in the lab. I am investigating several SUMO proteases in order to learn more about the regulatory pathways it is involved in. We are focused on the traditionally used protease from *Saccharomyces cerevisiae*, a thermophilic version from *Chaetomium thermophilum*, as well as several redesigns of a homologous protein from the *Saccharomyces* SUMO protease to improve solubility by mutating solvent-exposed hydrophobic amino acids to polar amino acids using a computational protein design program called Rosetta. I am using thermal melting techniques to find melting points and gel comparison techniques to analyze the efficiency of each protease. Understanding of the kinetics and properties of these proteases and comparing them to each other will yield a greater understanding of how the system works, which versions are more efficient for *in vitro* use, and how the system can be manipulated *in vivo*. The goal of my research is to create a set of biochemical tools associated with SUMO proteins to be used in cancer research, as the SUMO system is known to be dysregulated in cancer. Understanding of the role SUMO plays in cancer will provide context for the development of a new generation of therapeutics, and understanding of the SUMO system as a whole will improve a current biochemical technique.

## POSTER SESSION 4

MGH 241, Easel 136

4:00 PM to 6:00 PM

### Preventing Biofilm Formation: Rational Design of LapG Binders

Tessa Anne (Tessa) Howard, Senior, Public Health-Global Health

Mary Gates Scholar, UW Honors Program

Mentor: Christopher Bahl, Biochemistry

Many infectious diseases are caused by bacteria growing in biofilms, a group of cells that stick together and adhere to surfaces, such as the human lung or implanted medical devices. Biofilms affect millions of people worldwide each year, often contributing to death. When a biofilm is successfully established, bacteria are up to 1,000-times more resistant to antimicrobial agents and extremely resistant to clearance by the immune system. These molecular fortifications make bacterial infections difficult to treat, with the possibility of relapse weeks or months after the use of antibiotics. Many infectious diseases caused by biofilm-forming bacteria disproportionately affect the elderly and immunocompromised, like *Legionella* and *Bordetella*, which cause pulmonary infections. My research focuses on preventing biofilm formation, and forcing bacteria that have already formed a biofilm to disperse. Molecular engineering was used to design a protein to activate LapG, a protein effector responsible for balancing whether the bacteria are free floating versus anchored. When LapG is active, bacteria shed their adhesive proteins anchoring them to surfaces, and become free floating. I am trying to develop a protein-based drug to fight biofilm-based infections by permanently switching LapG to the "on position." Because this drug will be made of protein, there will be no toxic breakdown products, and the highly specific binding inherent to protein-based drugs will minimize the risk of side effects. Furthermore, protein-based drugs are genetically encodable, allowing us to genetically modify self-replicating probiotics, such as yogurt cultures or baker's yeast, to produce this medicine. This will empower low cost drug manufacturing and distribution because local communities in developing countries can produce these therapeutics using readily available cooking equipment and ingredients, and administer them without fear of overdose or toxicity. The goal is to test the LapG binder in animal models of chronic infection, eventually moving to human clinical trials.