

# Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

## Online Proceedings

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### POSTER SESSION 1

MGH 241, Easel 159

11:00 AM to 1:00 PM

#### **Relationship between Heat Exposure, Volume Status, and Kidney Injury in Washington Crop Workers**

*Gabino Abarca, Senior, Public Health-Global Health  
McNair Scholar*

*Mentor: June Spector, Environmental & Occupational Health Sciences and Medicine*

Chronic kidney disease of unknown cause (CKDu) is a major health problem in multiple areas of the world and may be caused by chronic intermittent dehydration in the setting of heavy physical work in hot conditions. Acute kidney injury has also been observed in US agricultural workers. Few studies have assessed the relationship between heat stress and early markers of kidney injury. Our overall study goal was to identify risk factors for dehydration and assess the relationship between heat exposure and biomarkers of kidney tubular dysfunction in Washington tree fruit harvesters. Forty-six tree fruit harvest workers from Eastern Washington participated in this cross-sectional study during the summer of 2015. Heat exposure was assessed as the max shift wet bulb globe temperature (WBGT). We assessed early kidney injury outcomes using pre/post-shift urine tubular function biomarkers ( $\beta 2$  microglobulin, NAG), dehydration using pre/post-shift urine specific gravity, and demographic and work factors using a survey. The association between heat exposure and tubular dysfunction was evaluated using mixed effects models. We identified potential factors that correlate with dehydration measured by increased urine specific gravity. We hypothesized that there is a positive correlation between higher post-shift urine specific gravity and longer distance to drinking water and bathrooms. We estimated the association of heat exposure with tubular kidney injury biomarkers. We also hypothesized that there is a positive association of  $\beta 2$  microglobulin and NAG with heat exposure (max shift WBGT). This study extends previous work examining the effects of heat exposure and kidney injury to include WA agricultural workers using early biomarkers of kidney injury. Results of this study add knowledge about the burden of heat health effects in agricultural workers and have implications for the prevention of adverse heat health effects in these workers.

### POSTER SESSION 2

Commons West, Easel 23

1:00 PM to 2:30 PM

#### **Characterizing the Ontogeny of Drug-Metabolizing Enzymes in Liver of Germ-Free Mice**

*Yasmin Everson, Senior, Extended Pre-Major*

*Mentor: Julia Cui, Environmental and Occupational Health Sciences*

*Mentor: Joseph Dempsey*

Newborns and children are at a much higher risk to adverse drug reactions, which is a significant public health problem. This is partially due to the lack of knowledge of the ontogeny of drug-metabolizing enzymes (DMEs). There are two types of DMEs, known as Phase-I and Phase -II DMEs. Phase I DMEs catalyze oxidation, reduction and hydrolysis reactions. Cytochrome P450s (CYPs) are a superfamily of Phase I oxidative enzymes responsible for the metabolism of a wide spectrum of drugs. Phase-II DMEs are responsible for various conjugation reactions including UDP glucuronidation, sulfonation and glutathione conjugation. Gut microbiome is known to regulate xenobiotic metabolism in adult mouse liver, but little is known of its potential involvement in the ontogeny of DMEs. The goal of this study was to determine the developmental regulation of Phase I and Phase II DMEs using germ free (GF) mice as a model. We bred both control and GF mice under the same housing conditions, and collected livers from male mice at the following ages: Days 1, 5, 10, 15, 25, 60, and 120. We isolated total RNAs and determined the RNA concentration using a Nanodrop spectrophotometer. We also determined the RNA integrity using gel electrophoresis by visualizing the 28S and 18S ribosomal RNA subunits. Using RT-qPCR we quantified the mRNAs of major DMEs and evaluated differences between control and GF mice using T-Test. As compared to age-matched control mice, the mRNAs of the xenobiotic-metabolizing Cyp3a11 was down-regulated in livers of GF mice at multiple ages including Days 10, 60, 120. Conversely, the expression of the lipid-metabolizing enzyme Cyp4a14 was up-regulated at the following ages: Days 5, 15, 60, and 120 in GF mice. In conclusion, our data suggest that the ontogeny of some DMEs is profoundly modified by lack of gut microbiota.

## POSTER SESSION 2

Commons West, Easel 27

1:00 PM to 2:30 PM

### **Environmental Screening of Poliovirus Using Recombinase Polymerase Amplification**

*Daysha Gunther, Senior, Public Health-Global Health*

*Mentor: John Scott Meschke, Environmental &*

*Occupational Health Sciences*

*Mentor: Nicola Beck, DEOHS*

Polio is on the cusp of worldwide eradication but remains endemic in Afghanistan and Pakistan. Nigeria's endemic status is being reconsidered because poliovirus was found in circulation after two years being polio-free. The Global Polio Eradication Initiative has implemented an environmental surveillance program to detect poliovirus (PV) in environmental samples such as sewage. Systematic environmental sampling provides supplemental data to disease-based clinical surveillance data. However, traditional PV detection methods from environmental samples, cell culture and quantitative reverse transcriptase polymerase chain reaction (RT-qPCR), are time consuming and expensive. Development of a screening test has potential to streamline environmental surveillance of PV. Reverse transcriptase recombinase polymerase amplification (RT-RPA) is an isothermal molecular amplification technique with potential as a screening test. In this technique virus particles are lysed to release RNA, which is converted to cDNA and amplified using recombinase enzymes. Amplified PV cDNA can then be detected through lateral flow detection. Collaborators at PATH have developed a RT-RPA protocol that has shown promise in rapid PV detection in stool samples. The aim of this research is to adapt PATH's clinical PV RT-RPA protocol for use with environmental concentrates and to determine the limit of detection. Concentrates will be obtained by filtering raw sewage from a Seattle wastewater treatment plant. Results of the RT-RPA test and subsequent visualization on lateral flow detection strip will be compared to cell culture and RT-qPCR. We anticipate that RT-RPA will show a similar limit of detection when compared to traditional methods and will be suitable as a rapid screening test for environmental concentrates. Future work will include determining the specificity of RT-RPA. Rapid PV detection with RT-RPA may streamline environmental surveillance methods, improve outbreak detection, and provide data for certification of polio-free status and global eradication.

## POSTER SESSION 2

Commons West, Easel 25

1:00 PM to 2:30 PM

### **The Effect of CAR Activation on the Expression of Long Non-Coding RNAs in Mouse Liver**

*Khak Khak Khayi, Senior, Biochemistry*

*Mentor: Julia Cui, Environmental and Occupational Health Sciences*

Long non-coding RNAs (lncRNAs) are defined as non-protein-coding transcripts longer than 200 nucleotides. Recent studies have recognized lncRNAs as crucial regulators of transcription, mRNA processing and protein activity. However, little is known regarding the pharmacological regulation of lncRNAs in liver, which is an important organ for xenobiotic biotransformation. The goal of this study was to investigate the correlation between lncRNAs and the constitutive androstane receptor (CAR/Nr1h3), which is a liver-enriched xenobiotic-sensing nuclear receptor that plays an important role in xenobiotic biotransformation and intermediary metabolism. Three genotypes of mice, namely wild-type (WT), CAR-null and humanized CAR-transgenic (hCAR-TG) mice at 5- or 60-days of age were administered a species-appropriate CAR ligand (TCPOBOP for mCAR, and CITCO for hCAR) or vehicle once daily for 4-days, and livers were removed on the 5th day. The lncRNA gene expression was determined using RNA-Seq (n=3 per group, Cuffdiff, FDR-BH<0.05). At Day 5 neonatal age, mCAR activation altered more lncRNAs than hCAR activation (877 vs. 234). Interestingly, only 87 lncRNAs were co-regulated by both mCAR and hCAR, whereas 790 were only regulated by mCAR, and 147 were only regulated by hCAR. At Day 60, mCAR activation also altered more lncRNAs than hCAR activation. Among the differentially regulated lncRNAs, 126 lncRNAs were co-regulated, 1110 and 87 were uniquely altered by mCAR and hCAR respectively. The results also showed the significance of age in the expression levels of lncRNAs. For example, mCAR activation produced more changes in lncRNA expression at Day 60 than at Day 5; however, this pattern was not observed in hCAR-TG mice. This study highlights the age and the species differences of the lncRNA regulation in liver following pharmacological activation of CAR. The differentially regulated lncRNAs may serve as novel biomarkers or therapeutic targets for human diseases such as metabolic syndrome and drug-induced liver injuries.

## POSTER SESSION 2

Commons West, Easel 28

1:00 PM to 2:30 PM

### **A Review of Transmission Pathways of Cholera with a Focus on Pregnant Women**

*Sophie Claire Morse, Junior, Microbiology*

*Mentor: John Scott Meschke, Environmental & Occupational Health Sciences*

In the past few years, cholera has caused many outbreaks of disease. Many studies have been done on its transmission

pathways and its effect on non-pregnant patients. This literature review focused on the application of research to discover the preferred recommendations for pregnant women in an outbreak of cholera. This project explored research in academic journals and other professional publications with keywords such as “cholera and pregnancy” and “cholera transmission.” We explored existing transmission pathways of cholera, as well as current recommendations for these specific cases. Such recommendations would be to prevent maternal illness and death, as well as diminishing the risk of fetal demise. It was found that cholera is present in biofilms and endemic in certain regions. Its contamination can be prevented through sewage, chlorination of water, and proper food preparation. This review used the disciplinary lenses of microbiology, clinical medicine, epidemiology, and public health. The information concerning cholera in pregnancy is conflicting regarding fetal demise pertaining to first or third trimester outcomes. However, there is overwhelming evidence pointing to the recommendation to vaccinate in the circumstances of an epidemic. Literature suggests that women who are pregnant are not at a higher risk of getting infected with cholera, however given a change in immune response, the fetus is at a higher mortality risk due to the mother’s emesis and dehydration. This review will suggest implementation in regards to vaccination and treatment options.

## POSTER SESSION 2

Commons West, Easel 20

1:00 PM to 2:30 PM

### **The Role of the Client in the Adherence to Veterinary Safety Practices**

*Bianca Irimia, Senior, Anthropology: Medical Anth & Global Hlth*

*Mentor: Heather Fowler, Environmental and Occupational Health Sciences, School of Public Health*

In the small animal clinical veterinary setting, the pet owner can play a key role in encouraging or discouraging the use of safety practices to prevent physical injury towards veterinary personnel. The factors that influence pet owners’ perceptions of these safety practices, however, are not well understood. In order to better understand their role in the injury pathway, we set out to conduct a study of current pet owners utilizing qualitative methods. Pet owners who have accessed veterinary services at least once in the 12 months prior to the study’s inception were invited to participate in focus group discussions regarding their perception of safety practices aimed at reducing physical injury to veterinary personnel in the veterinary clinic setting. Three qualitative focus groups of small animal pet owners were conducted in Seattle, WA during the month of November 2016. Each focus group consisted of 4-10 participants and lasted approximately 60 minutes. Questions asked during the focus group covered information re-

lating to veterinary worker behavior and practices, clinic environment, animal behavior, and human behavior and practices. The results of the interviews suggest that veterinary personnel-client communication plays a key role in the delivery of veterinary services. This overarching theme was found to influence how pet owners chose their veterinarian, as well as influenced their perceptions of the treatment areas, safety practices, and clinic policies. For instance, the lack of communication between veterinary personnel and clients resulted in negative perceptions of treatment areas and of the veterinary personnel themselves. Thus, personnel must work to improve communication with their clients in order to improve safety outcomes as well as the overall experience for the pet owner.

## POSTER SESSION 2

Commons West, Easel 24

1:00 PM to 2:30 PM

### **Developmental Regulation of Liver Transporters in Germ-Free Mice**

*Bolam (Hannah) So, Senior, Biology (General)*

*Mentor: Julia Cui, Environmental and Occupational Health Sciences*

Transporters are membrane proteins that modulate the absorption, disposition, and clearance of xenobiotics, and they are potentially involved in adverse drug reactions (ADRs). In the liver, which is the major organ for xenobiotic biotransformation, uptake transporters bring substrates into hepatocytes for further processing, whereas efflux transporters eliminate substrates out of the cell. In predicting pharmacokinetic effects, regulation of transporters may determine the availability of substrates to intracellular enzymes and affect the toxicological responses to xenobiotics. During development, profound changes occur in the expression of transporters, and understanding the age effect is crucial in predicting the efficacy and toxicity of therapeutic drugs for the pediatric population. Furthermore, age profoundly alters the gut microbiome, and this may alter certain microbial metabolites and modify the host response. Very little is known regarding the relationship between transporter regulation and gut microbiome during development. Therefore, the goal of this study was to determine the developmental regulation of transporters using germ-free (GF) mice as a model system. Both conventional (CV) and GF wild-type mice were bred under the same housing conditions, and livers were collected at the following seven ages: Day 1, 5, 10, 15, 25, 60, and 120 (n=5 per age per sex). RNA was isolated from the liver and the mRNA expression was determined using RT-qPCR. Significance was determined using a T-Test between age-matched CV and GF by sex. Our data show that expression levels of *Abcg5* and *Abcg8* are consistently higher in male GF than CV mice. For *Abcg5*, GF males at days 1, 60 and 120 and for *Abcg8*, GF

males at days 1, 10, and 120 had significantly higher expression levels than CV mice. Our result suggests that liver transporters may in part be regulated in a microbiome- dependent manner.

## 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.

## POSTER SESSION 3

Balcony, Easel 121

2:30 PM to 4:00 PM

### **Public Health Communication Methods: Perspectives from those Living as Homeless**

*Ryan Michel (Ryan) Kouchakji, Senior, Environmental Health*

*Mary Gates Scholar, UW Honors Program*

*Mentor: Tania Busch Isaksen, DEOHS*

This study recorded the perspectives of people living as homeless and found some significant differences in envi-

ronmental public health hazards and utilized communication methods between those living in city sanctioned encampments and non-sanctioned encampments. Seattle and King County, in Washington state, have had emergency levels of people living as -and becoming- homeless. In events such as extreme weather events, shelter food poisonings, changes in available resources, increased incidence of drug overdoses, or other emergent issues, public health departments will need tested communication infrastructure to distribute health related information to the homeless population. This study employed semi-structured interviews with question probes around environmental public health concerns and health communication methods in the local homeless population and amongst local agency leaders and health care practitioners. The study findings show that sanctioned encampments had better access to toilets, garbage disposal, and clean drinking water than non-sanctioned encampments. Additionally, the sanctioned encampments have security precautions and existing communication infrastructure such as camp meetings and camp phones that are not present in non-sanctioned encampments. Using the results of this study, there are some recommendations to improve communication between public health departments, homeless-focused organizations, and the homeless population.

## POSTER SESSION 3

Balcony, Easel 116

2:30 PM to 4:00 PM

### **Protocol Optimization of Oral Swab Analysis, a Novel Tuberculosis Detection Method**

*Alaina M Olson, Senior, Biology (General)*

*Mentor: Gerard Cangelosi, Environmental and Occupational Health Sciences*

*Mentor: Rachel Wood, Department of Environmental & Occupational Health Sciences*

Mycobacterium tuberculosis complex (MTBC) infects one third of the global population, with 5-10% developing active tuberculosis. As a contemporary global health concern, highly effective tuberculosis detection methods are crucial for diagnosis and control. The gold standard approach involves hazardous, difficult collection of sputum samples, followed by pathogen detection either by molecular methods (PCR) or bacterial culture. Oral Swab Analysis (OSA) uniquely uses oral swabs to collect epithelial and bacterial cells from the interior of the mouth. The swabs are then analyzed using an in-house extraction and quantitative polymerase chain reaction (qPCR) protocol. In a previous study, OSA accurately detected MTBC in 90% of TB patients. OSA provides a non-invasive, simpler, and faster detection method for MTBC. The current project aimed to optimize the sample preparation and qPCR detection methodologies. Of particular interest is a modified DNA re-suspension step that originally took 60

minutes and was performed using 5ul of a storage buffer. We hypothesized that a reduction in incubation time in conjunction with increasing the re-suspension solution to 15ul would have a negligible effect on the final DNA yield. Using spiked samples at known dilutions, re-suspension incubations were tested at fifteen and sixty minutes. The modified protocol produced DNA yields that outperformed the original protocol. The average changes in qPCR signal strength for the three dilutions were by 3.9, 4.9 and 5.1 units. Based on this performance, the modified re-suspension has been adopted into the official protocol. The modified protocol conserves valuable lab time enabling continued expansion of OSA benefits. Generating a faster turnaround time is not only relevant for high priority samples of this project, but for future TB detection application on a global scale.

observed higher concentrations of droplets in the WSP closest to the sprayed orchard, yet all the WSP showed evidence of drift. The results of this study will help provide evidence of pesticide drift and of methods to estimate drift exposure. This is important because the observations provide motive to look into ways to keep orchard workers safe from pesticide exposure.

## POSTER SESSION 3

**Balcony, Easel 114**

*2:30 PM to 4:00 PM*

### **Estimating Orchard Worker Exposure to Pesticide Drift using Water Sensitive Paper**

*Christine Perez Delgado, Senior, Public Health-Global Health*

*Mentor: Edward Kasner, Environmental and Occupational Health Sciences*

*Mentor: Richard Fenske, Environmental and Occupational Health Sciences*

Agricultural workers use pesticides to prevent insect damage to crops. There are state and federal regulations about how to handle pesticides safely. However, off-target drift is an undesirable consequence of pesticide application. The Washington State Department of Health tracks pesticide-related illnesses and found that orchard workers can experience pesticide drift exposure. The goal of this study was to use water sensitive paper (WSP) to measure pesticide drift downwind of an orchard where pesticides were being applied. First, we collected passive air samples by evenly distributing WSP at different downwind distances throughout the neighboring orchard in vertical and horizontal planes on two different days. On Day 1, we placed 15 horizontal samples 0.3 meters above the ground at distances 5, 26, and 52 meters downwind. One Day 2, we placed 4 vertical samples at 0, 2, 4, and 6 meters above the ground at the same 15 downwind locations (n=60). We then conducted an analysis to confirm the wind direction and speed. After drying, I analyzed the samples by taking pictures of the WSP and using photo-editing software to emphasize the contrast between the paper and droplet marks and correct perspective angles. I counted the droplets using bioimaging to measure the diameters of fine (106-235 um diameter), medium (236-340 um diameter), and coarse (341-403 um diameter) sized droplets. With this, I quantified the number and size of drift droplets on the WSP. We