



Undergraduate Research Symposium May 17, 2019 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

Commons West, Easel 38

11:00 AM to 1:00 PM

Diarrheal Illness during Pregnancy and its Effects on Birth Outcomes in Nepalese Mothers

*Katie Jean (Katie) Gustafson, Senior, Biology (Physiology)
Mary Gates Scholar*

Mentor: Helen Chu, Allergy & Infectious Diseases

Mentor: Kira Newman

Globally, poor and underserved countries tend to have an elevated incidence of infectious disease, often contributing to increased mortality rates. One health issue resulting from this is diarrhea, the 6th leading cause of mortality in developing countries. Because pregnant women are already vulnerable to infections due to an immune system that is rapidly adapting to a developing fetus, they may be more susceptible to diarrhea and the complications that come with it. We sought to identify whether diarrhea during pregnancy was associated with adverse birth outcomes, such as preterm birth and being small for gestational age. We used data from a prospective longitudinal study of maternal influenza immunization of pregnant women and their infants conducted in rural Nepal from 2011-2014. Diarrhea episodes were defined as three or more watery bowel movements per day for one or more days. The chi-square test, two-sample t-test, and log-binomial regression were performed to evaluate baseline characteristics and the association between diarrhea during pregnancy and adverse birth outcomes. From our study, we found that average weight and BMI at enrollment for women with diarrhea was significantly lower than those without diarrhea during pregnancy (47.6kg vs. 48.5kg, $p=0.01$, 20.72 BMI vs 21.06 BMI, $p=0.01$) and women with diarrhea during pregnancy were significantly more likely to have small for gestational age infants (42.6% vs. 36.8%, $p=0.03$). We also found that the incidence of non-live birth, preterm, and low birth weight did not significantly differ between mothers with and without diarrhea. By understanding the risks diarrhea during pregnancy poses for both mothers and infants, we can assess the severity of this problem, and whether or not a possible means of prevention should be prioritized. Further research should examine whether methods to improve weight and BMI during pregnancy prevents diarrheal illness and thus negative birth outcomes.

POSTER SESSION 2

MGH 241, Easel 130

1:00 PM to 2:30 PM

Developing a Nanofabrication Process for Manufacturing Integrated Passive Devices

*Julia L. Worden, Senior, Biochemistry
Lauren Arianna Mahdi, Junior, Materials Science & Engineering*

Mentor: Fred Newman

Mentor: Karl F. Bohringer, Electrical Engineering

The damascene process is an additive manufacturing technique commonly used in the nanofabrication industry to produce semiconductor devices. This process utilizes deposition and patterning of successive layers to produce interconnected copper patterns separated by interlayer dielectric. The goal of this project was to implement the damascene process to develop and refine methods at the Washington Nanofabrication Facility (WNF) for manufacturing multi-layer devices. For our purposes, we constructed an integrated passive device (IPD) that contains capacitors, resistors, and inductors. We utilized basic nanofabrication tools in our damascene process including deposition, photolithography, etching, electroplating, metrology, and polishing tools. In fabricating this method at the WNF, our main objective was to produce a highly repeatable device with structural integrity. The main challenges accompanied with this involved generating a successful etch on all three layers of the IPD and optimizing polishing conditions. Cross sections of the final product were analyzed in order to demonstrate that the layout expected from the process was achieved. The procedure we developed can be applied to future multi-layer damascene processes at the WNF. Multi-layer devices are significant in the semiconductor industry as they allow for high packing density and an increased variety of circuit configurations in a compact device.

POSTER SESSION 2

MGH 241, Easel 129

1:00 PM to 2:30 PM

Refinement of Atomic Layer Deposition Parameters to Achieve Optimal Sidewall Coverage

Mark Sterling Forsnes, Senior, Mat Sci & Engr: Nanosci & Moleculr Engr

Mentor: Fred Newman

Mentor: Karl F. Bohringer, Electrical Engineering

Atomic Layer Deposition (ALD) is a process whereby thin films of a material, ranging from dielectric materials to metals, are deposited onto a substrate. ALD reactions operate using two vapor phase chemical precursors that react with the substrate material sequentially one at a time, slowly forming the thin film. Because of the sequential nature of ALD, the process is self-limiting and offers exceptional control of thin film thicknesses, film composition, and high conformity on high aspect ratio features, such as trenches and sidewalls, making ALD an extremely useful process for the fabrication of semiconductor devices. The purpose of this project was to develop processes and refine process parameters for thin film deposition using an industry grade ALD machine. Thin films were deposited onto silicon substrates with etched features. The films were then examined and characterized using ellipsometry and sidewall conformity was measured using a scanning electron microscope. This data was used to refine processes and parameters that were then employed by research staff and industry users in the fabrication of semiconductor devices. Overall, this data can be employed by the semiconductor industry to better understand this process and utilize it to manufacture silicon devices with greater uniformity and efficiency.

POSTER SESSION 4

Balcony, Easel 106

4:00 PM to 6:00 PM

What is the Time Burden Associated with Completion of Health-Related Quality of Life Questionnaires after Cancer Treatment?

Wesley Jenq, Junior, Biology (Physiology)

Mentor: Fredrik Klevebro, Thoracic Surgery, Virginia Mason Medical Center

Patient reported outcomes (PRO) are becoming increasingly important in the follow-up of patients after cancer treatment. The specific aim of this study was to investigate the time taken and completeness of PRO questionnaires. Study subjects were identified from an institutionally approved database of patients who had undergone surgical management of esophageal cancer with curative intent (1991-2018). Patients that were alive in April 2018 were asked to complete six questionnaires, including: Digestive Symptom Questionnaire (DSQ, 23 questions); Dumping Syndrome Rating Scale (DSRS, 25 questions); SF36 (36 questions); EORTC-QLQ-C30 (30 questions); EORTC-QLQ-OG25 (25 questions); and EuroQol 5D (6 questions). Patients were of-

ferred either hard-copy (paper) or Electronic versions of the questionnaires. Electronic questionnaires compiled in Red-Cap were completed consecutively by patients allowing for accurate quantification of the time taken to complete each questionnaire. In total, 144 patients were asked to participate, 117 patients (81.3%) agreed to complete questionnaires, of whom 60 (51%) of the patients choose the electronic version. Completion rates for all of the questionnaires was 91% (52 patients) and 85% (51 patients) for paper and electronic versions respectively. The average age of patients choosing electronic questionnaires was 74 (range 55-96) years compared to 71 (range 53-91) years in the paper questionnaire group. On average, the 6 questionnaires, consisting of 145 questions, took 26.9 (range 10-55) minutes to complete: 7.5 minutes for DSQ, (range 1-39 min), 4.4 min for DSRS, (range: 1-19 min), 6.8 min for SF-36, (range: 3-18 min), 3.7 min for EORTC-QLQ-C30, (range: 2-8 min), 2.7 min for EORTC-QLQ-OG25, (range: 1-5 min), 1.7 min for EuroQol 5D, (range: 0-6 min). In conclusion, the high response rate in the study, indicates that it is feasible to ask patients to answer multiple PRO questionnaires after cancer treatment. Continued focus on PROs is warranted to further increase the knowledge of cancer survivorship.

POSTER SESSION 4

Commons West, Easel 37

4:00 PM to 6:00 PM

Classification of Behavioral and Neural Variation in Individuals with Autism Spectrum Disorder

Josephine Ella Millard, Senior, Biology (General)

Mentor: Frederick Shic, Pediatrics

Mentor: Adham Atyabi

Mentor: Kelsey Dommer, CHBD, SCRI

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition associated with deficits in social interaction and the presence of restricted patterns of behavior. ASD is clinically and phenotypically heterogeneous. The most recent update to the diagnostic definitions for mental disorders (DSM-5) provides additional flexibility for capturing the diverse array of phenotypes shown by diagnosed individuals. Despite categorized behavioral symptoms across core and comorbid dimensions of ASD, the neural mechanisms are unknown. Studies have shown atypical neuroanatomy and functional connectivity of the brains of individuals with ASD, suggesting a neural etiology. Here, we focus our attention on the superior temporal sulcus (STS), a region of the brain demonstrated to play a role in processing communication, social information, and theory of mind. Our research question evaluates whether neural activity in STS is affected by behavioral phenotype in children with ASD. We speculate that neural activity between individuals with ASD varies significantly more than typically developing (TD) children, who show more clustered, simi-

lar outcomes. Functional near infrared spectroscopy (fNIRS) distinguishes concentrations of oxygenated (HbO) and deoxygenated (HbR) hemoglobin in regions of cortical vasculature, signifying neurovascular coupling. This study uses HbO and HbR measured as subjects watch the events of a social scene on a monitor and analyzes ASD individuals' deviance from average TD activity. Eye-tracking, clinical assessments, and parent questionnaires are considered to extrapolate possible correlations between ASD individuals' variation in neural outcome and the behavioral phenotype expressed. We expect that individuals showing higher degree of neural variance from TD activity will show more severe autism behavioral phenotype. It is possible that in the search for neural mechanisms of ASD, considering behavioral factors signifying atypical variance could reveal significant differences. This exploratory analysis aims to examine the wide range of possible influential factors on neural heterogeneity within the social brain of individuals with ASD.