

**Seventeenth Annual
Medical Student
Research Symposium**



**Pinn Hall
University of Virginia School of Medicine
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11:30 AM – 2:30 PM**

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Poster #1

Thoracic And Cardiovascular Surgeons Achieve High Rates of K Award Conversion into R-level Funding

Adishesh K. Narahari MS, J. Hunter Mehaffey MD MSc, Robert B. Hawkins MD MSc, Pranav K. Baderdinni, Anirudha S. Chandrabhatla, Irving L Kron MD, Mark E Roeser MD, Dustin Walters MD, Gorav Ailawadi MD
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Objectives Obtaining NIH R01 funding remains extremely difficult. The utility of career development grants (K awards) to successfully reach the goal of R01 funding remains debated, particularly for clinical-investigators in demanding specialties. We sought to determine the success rate for thoracic and cardiovascular (TCV) surgeons compared to other specialties in converting K-level grants into R-award equivalents.

Methods All K (K08, K11, K23) grants awarded to surgeons by the National Institutes of Health (NIH) between 1993-2017 were identified through the NIH Research Portfolio Online Reporting Tool Expenditures and Results (RePORTER), an online database combining NIH funding records, publications, and data from the U.S. Patent and Trademark Office. Only grants awarded to surgeons in cardiac, thoracic, or vascular surgery were included. Active grants or grants active within the past year were identified and analyzed separately. Mann-Whitney U-tests and Chi-squared tests were used to compare groups.

Results A total of 65 K-level grants belonging TCV surgeons were identified, including 17 of which were still active within the last year and excluded from analysis. Twenty four (50%) TCV awardees with a completed K grant successfully transitioned to an R-level equivalent grant. Awardees with successful conversion published 11.29 publications per K grant compared to 7.25 publications for those who were unsuccessful ($p=0.076$). TCV K awardees obtained their first R grant 5.00 years after the beginning of their K award. The 10-year conversion rate to R-level grant equivalent was significantly higher for TCV surgeons compared to all other peers (58.9% vs 42.5%, $p=0.038$).

Conclusions TCV surgeon-scientists have a higher 10-year conversion rate to first R award than their peers. New career development grants are critical for R01 funding and the NIH receives a good return on investment when funding TCV surgeon-scientists.

Poster #2

Incidence of Thyroid Disease in Patients with Forefoot Deformity

Sterling Tran

Background - Hallux valgus and lesser toe deformities are common foot disorders with substantial functional consequences. While the exact etiologies are multi-factorial, it is unknown if certain endocrine abnormalities, such as thyroid dysfunction, may be associated with these pathologies. The current study sought to investigate the prevalence of thyroid disease in patients with hallux valgus or lesser toe deformities.

Methods - Every new patient who presented to our institution's foot and ankle clinic during a three-month time period was given a survey to determine the presence of a known thyroid disorder. The diagnosis for each visit was then recorded. Additionally, a national, publicly

available database was queried for patients diagnosed with thyroid disease and concomitant hallux valgus or specific forefoot pathology. Odds ratios for the presence of thyroid dysfunction were then calculated for each patient group.

Results – Three-hundred and fifty initial visit patient surveys were collected, and 74 (21.1%) patients had a known diagnosis of thyroid disease. The most common diagnoses were primary hypothyroidism (n=61, 17.4%), secondary hypothyroidism (n=6, 1.7%), thyroiditis (n=4, 1.1%), and hyperthyroidism (n=3, 0.9%). Thyroid disease was present in 16 of 24 patients (66.7%) with a diagnosis of hallux valgus (OR 7.3, CI[3.16-16.99], $p<0.0001$). Lesser toe deformities, including hammertoes, mallet toes, bunionettes and crossover toes, were also significantly associated with thyroid disease (OR 5.45, CI[1.83-16.26], $p<0.002$). The national database revealed 905,924 patients with a diagnosis of a specific forefoot deformity, and 321,656 of these patients (35.5%) had a concomitant diagnosis of a thyroid condition (OR 2.1067, CI[2.098-2.12], $p<0.0001$).

Conclusion - The current study suggests a significant association between forefoot pathology and thyroid dysfunction, especially hallux valgus and lesser toe deformities. Increased understanding of these correlations may offer an important opportunity in population health management, both in diagnosis and treatment. While further studies with long-term outcomes are necessary, the early diagnosis of thyroid disease may provide an opportunity to predict and potentially alter the course of forefoot pathology.

Keywords – Thyroid disease; Hypothyroidism; Hyperthyroidism; Forefoot pathology; Lesser toe deformity; Hallux valgus

Poster #3

Caloric Restriction Extends Chronological Lifespan of Budding Yeast Through a Cell Non-autonomous Mechanism

Elisa Enriquez Hesles¹, Nazif Maqani¹, Ryan D. Fine¹, Margaret Wierman¹, Matthew Hirschey², Daniel L. Smith, Jr³, John L. Hartman, IV⁴, and Jeffrey S. Smith¹

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Caloric restriction (CR) has been shown to extend lifespan in a variety of model organisms ranging from yeast to mammals. Our lab focuses on chronological lifespan (CLS) of the budding yeast, *Saccharomyces cerevisiae*, defined as the number of days that non-dividing cells remain viable in stationary phase. CR involves reducing glucose in the growth medium from 2% (non-restricted; NR) to 0.5%. Multiple conserved nutrient signaling pathways have been implicated in regulating CLS via CR, including TOR, Sch9, and Snf1 (AMPK). Interestingly, we determined that conditioned media from CR stationary phase cultures can be concentrated and supplemented into NR cultures to extend CLS, suggesting one or more CR longevity factors work through an uncharacterized cell non-autonomous mechanism. RNA-seq analysis after treatment with the CR concentrate suggests induction of general stress responses, including remedies to ethanol and acetic acid stress, consistent with current models of yeast aging. Based on size exclusion chromatography and various treatments such as heat, phenol extraction, nuclease digestion, etc., we hypothesized the active factor(s) were water-soluble metabolites smaller than 700 daltons. Metabolomics analysis comparing conditioned CR and

NR media then revealed several amino acids specifically enriched in the CR samples, with serine being the strongest hit. Indeed, serine supplementation was sufficient to extend the CLS of non-restricted yeast cells in a dose-dependent manner. The serine effect on lifespan appears to be conserved in *C. elegans*, and we are currently testing in *Drosophila*. Our working model is that serine supplementation mimics CR by promoting the maintenance of cellular quiescence.

Poster #4

CD8+ T effector memory RA+ Lymphocyte Sorting as Controls for LGL Leukemia

Hee Jin Cheon, Jeffrey C. Xing, Megan Nguyen, Deborah Powers, Matthew W. Schmachtenberg, Jun Yang MD, Thomas L. Olson PhD, David J. Feith PhD, Thomas P. Loughran Jr. MD

T-cell large granular lymphocyte (LGL) leukemia is characterized by clonal proliferation of CD8+ T cells. Disease features that are frequently observed include neutropenia, anemia, and rheumatoid arthritis. Normal counterpart to LGL leukemic cells is thought to be terminal effector memory CD45RA+ T cells (TEMRA). Number of TEMRA cells is known to increase with age, but TEMRA biology is not fully understood. Knowledge of “normal” TEMRA signaling is important for comparison against leukemic cells. Therefore, the goal of this study was to isolate CD8+ subpopulations including TEMRA from healthy matched individuals for comparison with LGL leukemia using flow sort. Isolation of CD45RA+ CD62L+ TEMRA cells was successful, though more stringent markers may be needed to increase purity. In healthy donors with age 45+, TEMRA cell yield was ~25% of cytotoxic T-cells (~1-3% of PBMC). Frozen samples work just as fine as fresh samples for TEMRA isolation with minimal loss, albeit with some increased dead cells. We also observed that CD4+ population has a TEMRA component, and their CD45RA expression was lower than CD8+ cells. DNA yield from isolated CD8+ subpopulations were low at about less than 100ng per 300,000 cells. Pooling of samples or using a different DNA extraction approach may help increase yield. For future directions, we will assess genome-wide DNA methylation levels for normal T cell population as well as TEMRA cells and compare with leukemic LGL cells.

Poster #5

Evaluating the effect of education on symptom onset and severity in Huntington disease

Kristina Cain

Objective: To evaluate the relationship between education level and age of diagnosis, symptom onset, and symptom severity in Huntington disease (HD).

Methods: This study evaluated 4,537 adult-onset motor-manifest HD participants from the ENROLL-HD global registry. Education level was assessed using International Standard Classification of Education (ISCED) categories, with scores ranging from 0 to 6. ISCED categories were classified into three education groups corresponding to pre-secondary (ISCED 0-2, n=1,115), secondary (ISCED 4, n=1,491), and post-secondary educational attainment (ISCED 4-6, n=1,931). Motor and behavioral symptoms of HD as well as functional capacity were measured using the baseline Unified Huntington's Disease Rating Scale (UHDRS), Problem Behaviors Assessment-Short, Mini-Mental State Exam (MMSE), Symbol Digit Modalities Test (SDMT), verbal fluency, and Stroop assessments.

Results: Linear regression models adjusted for CAG repeats showed that higher levels of education were associated with earlier onset of motor, depression, and cognitive symptoms. Linear regression models adjusted for age of enrollment and CAG repeats showed that higher education level was associated with lower UHDRS motor scores, higher UHDRS total functional capacity and functional assessment scores, and higher SDMT, MMSE, verbal fluency, and Stroop assessment scores (all p-values<0.001).

Conclusions: HD participants with higher education levels have earlier age of diagnosis and age of symptom onset, but they have lower motor exam scores and higher scores on functional assessments. Earlier recognition of symptom onset in higher educated populations may explain earlier symptom onset and diagnosis, while better performance on motor and functional assessments may be explained by higher cognitive reserve in those with greater education.

Poster #6

Managing Group A Strep – Making a Diagnosis

Vi Nguyen

Background: Acute pharyngitis is a common cause for pediatric visits. Although viral etiologies account for the majority of cases, Group A streptococcus (GAS) is the most common bacterial cause. The Infectious Diseases Society of America (IDSA) issued guidelines for diagnosing and managing children and adults with pharyngitis to minimize improper diagnostic testing, inappropriate antibiotic use, and misdiagnoses. This study aims to determine whether pediatricians adhere to these guidelines.

Methods: A 25 question survey was emailed to practicing pediatricians in Maryland, District of Columbia, Virginia, and North Carolina. The survey consisted of case scenarios, questions concerning clinic practices, antibiotic use, and demographics. Data was analyzed using Statistical Analysis Software.

Results: 182 surveys were completed and analyzed. Responses to the case scenarios varied. IDSA guidelines advise against obtaining rapid strep tests in children <3 years old, but 59.34% of pediatricians chose to obtain a rapid strep test in a 14-month-old (case 1). In cases where children had viral symptoms, only 30.77% (case 2) and 49.45% (case 4) of pediatricians properly advised symptomatic treatments and abstained from using rapid strep tests, antibiotics, or scoring systems. The majority of pediatricians did follow guidelines in cases where patients had clinical signs suggesting GAS (case 3, 86.26%), with patients presenting with recurrent GAS infection (case 5, 60.44%), and with patients exposed to ill GAS contacts (case 6, 58.24%).

Conclusions: Pediatricians vary in how they manage and diagnose GAS pharyngitis. The majority of pediatricians did not adhere to IDSA guidelines.

Poster #7

Narrowing the Gap in Health Disparities for Latinos through the UVA Latino Health Initiative

Bijan Morshedi (SOM Class of 2020), Dr. Max Luna (Cardiology)

Other contributors: Emily Schutzenhofer, Maren Leibowitz, Tessa Klumpp, Idorenyin Ndem, Esteban Cubillos-Torres, Janet Arras, Deson Haynie, Daniel Giraldo

Goals of the Program: The UVA Latino Health Initiative (LHI) strives to contribute to the health and wellbeing of the Latino community in the Charlottesville area while enhancing cultural humility and competency among UVA students and faculty through three unique programs: La Clínica Latina, the Cardiovascular Initiative for Latino Community Health (CVI-LCH), and the Compañeros Training and Empowerment Program (CTEP).

Methodology: The Clínica Latina has 40 trained student volunteers and 9 physicians that staff La Clínica in the Charlottesville Free Clinic (CFC), where low income Latinos receive empathetic and culturally sensitive primary care in their Language. In the CVI-LCH Patients can receive biweekly blood pressure (BP) evaluation and cardiovascular and diabetes prevention education in Spanish at a local parish with the collaboration of LHI community health workers. The CTEP, partners Latino community health workers (CHWs) with UVA medical students and faculty to advanced their knowledge and skills for community health education, screenings, and health care navigation.

Results: Increased trust from the Latino community and availability of reduced cost healthcare have led to high demand for service at La Clínica. The program now serves biweekly to meet the increased healthcare interest demonstrated by the Latino community increasing the Latino participation in the Charlottesville Free Clinic from 15% to 21%.

325 total participants have had their BP screened in 2016-2017. Of these people, 117 have returned for follow up BP screenings at least once. 30% of participants lowered their mean BP readings. 11 active CHWs completed over 40 hours of training on topics such as CVD prevention, diabetes, mental health, cervical cancer, STIs, and public speaking in addition to their community service dedications over the last 2 years.

Conclusions: The UVA LHI has grown significantly over the past few years while connecting Latinos to linguistically and culturally appropriate healthcare at UVA. It is now one of the leading community health programs in the University of Virginia and Charlottesville, VA.

Poster #8

Perioperative Narcotic Use and Total Shoulder Arthroplasty: Trends, Risk Factors, and Complications

Moran, Thomas B.S., Gause, Trent M.D., Werner, Brian, M.D.

Introduction: The aim of the present study was to 1) examine trends regarding preoperative and prolonged postoperative narcotic usage in total shoulder arthroplasty (TSA) procedures, 2) identify risk factors that predispose individuals for prolonged postoperative narcotic use after TSA, and 3) examine both preoperative and prolonged postoperative narcotic use as independent risk factors for certain complications after TSA.

Methods: This is a retrospective study utilizing a large insurance database to identify patients undergoing primary TSA between 2007-2015. Information regarding demographics, comorbidities, and complications were collected. Preoperative narcotic use was defined as a new narcotic prescription between four months and one month prior to undergoing TSA. Prolonged postoperative use of narcotics was defined as a new prescription between three and six months after undergoing TSA. Multivariable logistic regression analysis was used to identify risk factors for prolonged postoperative narcotic use. Regression analysis was likewise used to examine the correlation between narcotic use and the risk for postoperative complications, including infection and need for revision TSA.

Results: 12,617 patients were identified. There was noted to be a slight, yet statistically significant decrease in preoperative and prolonged postoperative narcotic use surrounding TSA between 2007 and 2015. This study also identifies several patient-specific risk factors for prolonged post-operative narcotic use after TSA, the most significant of which is a patient's pre-operative narcotic use in a dose-dependent manner. Other risk factors identified included preoperative use of anxiolytics, muscle relaxants, and methadone; tobacco and alcohol use; age < 50, depression, lumbago, and fibromyalgia. With regard to outcome, preoperative narcotic use was correlated with an overall risk for post-operative infections. Prolonged postoperative narcotic use also conferred an increase in risk for infection and need for revision TSA.

Discussion: Preventing the misuse of narcotics requires an understanding of epidemiology and predisposing risk factors, as specific patient demographic components and medical comorbidities suggest increased risk for prolonged narcotic use after TSA. The results of this study also bring awareness to trends in narcotic use surrounding TSA, and help provide an increasing recognition as to the potential for negative outcomes in orthopedic surgery with perioperative narcotic use. Prescribing narcotics following TSA may be done with recognition of risk and in conjunction with the use of non-narcotic, multimodal analgesia.

Poster #9

The Effect of Body Language Training and Gender on Patient Perception of Physician Intelligence, Confidence, and Competence

Christopher J. Kaperak, Katherine T. Forkin, Lauren K. Dunn, Jennifer F. Potter, Allison J. Bechtel, Amanda M. Kleiman, Julie L. Huffmyer, Stephen R. Collins, Genevieve R. Lyons, Jennie Z. Ma, and Edward C. Nemergut

Background: Patient perception of physicians is important, yet the role of body language and physician gender on patient perceptions has not been investigated. We hypothesized that patients perceive physicians displaying confident body language as more capable and judge them to be more intelligent, more confident, and more competent. We also hypothesized that patients would prefer male anesthesiologists over female anesthesiologists.

Methods: Two hundred patients presenting to the Preanesthesia Evaluation and Testing Center (PETC) were enrolled. Participants viewed four 90-second videos in random order. Each video featured a male or female anesthesiologist displaying confident, "high power" or unconfident, "low power" poses (Figure 1). Each actor recited the same script describing general anesthesia and the associated risks. Participants ranked each physician on perceived confidence, intelligence, and their likelihood of choosing that physician to care for their family member. Participants also chose the one physician who seemed most like a leader. Data were analyzed using a generalized mixed-effects multinomial logistic regression model.

Results: Physicians displaying confident, “high power” body language were 2.27 times more likely to be ranked as more confident (95% CI, 1.76 to 2.92; $p < 0.0001$), 1.69 times more likely to be ranked as more intelligent (95% CI, 1.13 to 2.18; $p < 0.0001$), and 2.34 times more likely to be chosen to care for one’s family member (95% CI, 1.82 to 3.02; $p < 0.0001$) as shown in Table 1. Additionally, physicians displaying confident poses were 62% more likely to be considered a leader ($p < 0.0001$). Physician sex had no impact on any measures.

Conclusions: Patients perceive physicians who display confident, “high power” body language as more confident, more intelligent, and more like a leader and are more likely to choose that physician to care for their family member. Patient perceptions were not affected by the physician’s sex. We recommend incorporating body language training into medical education.

Poster #10

Characterization of Extra-Thymic AIRE Expressing Cells

John Rose*, Jhoanne Bautista[†], MD, PhD, Jay Gardner[†], MD, PhD, Mark S. Anderson[†], MD, PhD

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Extra-Thymic AIRE Expressing Cells (eTACs) are a recently discovered tolerogenic antigen presenting cell population that is capable of inducing deletion of self-reactive CD8 T-cells and causing functional inactivation of autoreactive CD4 cells. Mouse models demonstrate that eTACs are able to prevent autoimmune attacks on pancreatic islets thereby providing a mechanism for Type 1 DM prevention. Despite their prominent tolerogenic function, this cell population is still incompletely characterized. We hypothesize that eTACs are a distinct subset of tolerogenic dendritic cells (DCs) that may have a significant role in maintaining immune tolerance particularly as the thymus involutes with maturity. To better characterize eTACs, we performed flow cytometry and adoptive transfer experiments to demonstrate that they are migratory DCs that have interactions with CD4 T cells distinct from conventional dendritic cells (cDCs). Our experiments demonstrated a significant subset (3.7-15.8%, $n=3$) of migratory dendritic cells express AIRE, and as a corollary to this finding, CCR7^{-/-} mice had a significant decrease in eTAC abundance in lymph nodes relative to control mice (CCR7^{-/-} [$n=3$] mean of 5.6 vs. control [$n=2$] mean of 2.14, $p=0.004$), likely because deletion of CCR7 prevents DC migration to lymph nodes. Adoptive transfer of self-reactive OTII cells into host mice where OVA is solely presented on either cDCs or eTACs showed a difference in proliferation pattern as early as 16 hours post injection. Lastly, we found that eTAC numbers increase with age while mTECs did not. Together, these results characterize eTACs as a migratory dendritic cell population that are relatively more abundant in older age. We report that eTACs are tolerogenic migratory dendritic cells that are robust enough for potential therapeutic applications through adoptive transfer.

Poster #11

Microneedles are a Novel Drug Delivery Method

Timothy Chastanet¹, Li Jin¹, Li Xiao¹, Matthew Chen¹, Naga Nannapuneni¹, Xudong Li¹
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INTRODUCTION: Medications are commonly delivered orally, intravenously, or topically, but all of these routes have significant drawbacks. Oral medications are often affected by first pass

metabolism of the liver and have systemic side effects. Intravenous delivery requires a needle stick, which can be difficult in some circumstances such as hypovolemia or children. Topical application of a patch or ointment is very slow and most of the medication is wasted. Microneedles are a rising star in drug delivery because they don't have first pass liver metabolism, are mostly localized, have minimal blood or pain, are easily and quickly delivered, and have relatively little drug lost. In this study, we used dexamethasone as a model drug to demonstrate the effectiveness of microneedles.

METHODS: Four sizes of molds and many different techniques were tried until the optimal microneedles were made based on visualization of the needles under the microscope. A mouse model was used for the application of dexamethasone microneedles. The ears were inflamed, and then dexamethasone vs. blank microneedles were applied. The dexamethasone microneedles were also dissolved in water and the concentration was measured to determine the speed of release.

RESULTS AND DISCUSSION: The width of the mouse ears was less with the application of dexamethasone microneedles than with blank microneedles. This suggests that the delivery of dexamethasone was successful and that the drug reduced the inflammation. The drug release profile showed approximately all of the drug delivery in the first 5 minutes of application.

SIGNIFICANCE/CLINICAL RELEVANCE: Microneedles are a nontraditional method of drug delivery that has the speed of a needle with the ease of a patch.

Poster #12

A Pilot Study of Circadian and Intra-Individual Variations in Post Prandial Peripheral and Hepatic Insulin Action

Bowen Sheng, Rita Basu, Ananda Basu, Davide Romero, Yogesh Yadav

In diabetic patients, it has long been understood that their long-term health outcome is directly correlated with their degree of long-term glucose control. It is also known that such control is dependent on the balance between the rate of appearance of glucose and rate of disappearance in the blood, which reflects the individuals' meal intake, glucose uptake by the body, and endogenous glucose production. However, there has not yet been an identified pattern for postprandial glucose metabolism as it varies throughout the day. Prior studies conducted have used the dual-tracer technique, a technique used to estimate rate of appearance of meal derived glucose, endogenous glucose production, and rate of disappearance. These studies have been shown to be limited by the dual-tracer technique's inability to obtain accurate data due to rapid perturbations of tracer-tracee ratios. We have corrected for this by implementing the validated triple-tracer technique for a model-independent accurate estimation of the above variables. Currently, there are no studies using the triple tracer technique that have evaluated the circadian pattern of glucose kinetics in type 2 diabetic patients. In this pilot study, we are utilizing the triple tracer technique to determine if a diurnal pattern of endogenous glucose productions exists in type 2 diabetics and if it differs from non-diabetic healthy controls. Our study analyzes the postprandial endogenous glucose production, rate of glucose appearance, postprandial high blood glucose index, and postprandial insulin action in subjects with and without type 2 diabetes over three consecutive days while controlling for meal composition and treatment. An improved understanding of how our body metabolizes glucose will allow us to optimize therapies for type 2 diabetics for better glucose control and limit postprandial hyperglycemia, thereby improving health outcomes for those patients.

Poster #13**A rare case of non-fatal tumor lysis syndrome in metastatic prostate adenocarcinoma**

Michael Dougherty MS3, Jigna Solanki MD, Matthew Reilley MD

Tumor lysis syndrome (TLS) is a medical emergency that occurs in the setting of large-volume tumor cell lysis and release of intracellular substances into circulation. TLS most commonly occurs with hematologic malignancies but has been reported in various solid tumors, most commonly with advanced disease shortly after beginning cancer therapy. There have been 9 reported cases of TLS in prostate adenocarcinoma; most occurred after beginning hormone therapy, chemotherapy, or radiation but 2 occurred spontaneously. All previously reported cases have been fatal. Here we describe the initial presentation and hospital course of the first non-fatal case of TLS in prostate adenocarcinoma. Our patient presented while off of all therapy for his cancer. He met the Cairo Bishop Laboratory TLS criteria with hyperuricemia and hyperphosphatemia, and clinical TLS criteria with an elevated creatinine. He received prompt treatment with IV fluids, rasburicase, and hemodialysis. To our knowledge, this is the first reported case of a prostate cancer patient to survive TLS; our experience suggests that with appropriate and aggressive management, TLS due to prostate adenocarcinoma is not universally fatal.

Poster #14**Gut Microbiome-Generated Short Chain Fatty Acids Entrain Circadian Rhythms in Intestinal Epithelial Cells via an Epigenetic Mechanism**

Jesse Zhao, Dr. Sean Moore

The circadian clock is a diurnal, biological oscillator that plays an important role in human health and homeostasis. Oscillations of the gut microbiome linked to host circadian rhythms have been previously shown. The composition of the microbiome, the localization of the microbiome within the GI tract, and the metabolites regulated/produced by the microbiome all vary diurnally and are linked to the host circadian clock (Liang et al, 2015; Mukherji et al 2013; Thaïss et al 2016; Leone et al, 2015). Here, we elaborate upon this finding by showing a bidirectional relationship between the host GI clock and its microbiome mediated by non-juxtacrine mechanisms such as microbial produced- and modified- metabolites. Host clock activity was measured by PER2 gene transcription levels and *Bmal1* protein expression levels in mouse enteroid-derived gut models, which oscillate in accordance with the circadian cycle. Here, we show that certain bacterial species, such as *Clostridium* and *Bacteroides*, shift the clock by phase alteration in a dose-dependent manner, while others, such as *Lactobacillus*, do not. A random forest machine learning approaches identifies the short chain fatty acids butyrate, propionate, acetate, and isovalerate as modulators of circadian timing by phase alteration. Others, such as formate and choline, do not impact the host clock. Mechanistically, we demonstrate that short chain fatty acid mediated phase alteration is augmented by MAP kinase activity, independent of NF-κB signaling and pH. Last, we show that pharmacological inhibitors of HDAC, trichostatin and SAHA, closely mimic the effects of butyrate on PER2 phase and that mithramycin, an inhibitor of HDAC inhibition, reduces the magnitude of butyrate-induced phase delay by 2 to 3 hours, a 20-30% reduction in the typical 10-hour phase delay.

The results of our study open novel opportunities for microbiome-based chronotherapy. These include the potential to reduce gut inflammation, prevent jet lag dysbiosis through microbiome or microbial metabolome-mediated host clock alterations (Thaiss et al, 2014), to treat sleep disorders, and help shift workers better acclimate to time of day (Suwazono et al, 2008).

Poster #15

eConsultation to Hematologists from Primary Care: An Assessment of Content and Patient Impact

Megan Leslie B.S., Sa Ra Park M.D., Jennifer Wang M.D., Kelly Davidson M.D., Kimberly Dowdell M.D.

Introduction: National referral rates and wait times to see specialists continue to increase, contributing to the continued rise of health care cost in the United States. Electronic consultations (eConsults) are text-based inquiry responses between providers and consultants that represent a potential means of ameliorating this trend. eConsults have been shown to improve access to specialist care while increasing patient satisfaction and decreasing unnecessary specialist visits. However, there is little research about the impact and content of eConsults within hematology. We aim to study the most common topics queried by PCPs to hematologists via eConsult, and to evaluate the impact of eConsults on patients.

Methods: This retrospective study included eConsults made to benign hematology at a single US based tertiary care academic medical center from December 1, 2015 to June 1, 2018. The patient population included patients established with primary care physicians within the hospital network. For data collection, we modified a template used to analyze eConsultations to gastroenterology developed by the authors (JW, SP). Data review included patient demographics, type of query, clinical content, specialist response time, and eConsult outcome.

Results: Content of eConsults: Overall, 82 different topics were addressed in a total of 350 eConsults. Questions asked were most likely diagnosis or further workup of disease (56%), followed by patient management (38.5%) and lab interpretation (7.5%). Question content fell into one of eight general categories, including anticoagulation (22%), anemia (22%) and abnormal lab result (21%). Specific topics with a high rate of resolution via eConsult included: macrocytic anemia (93%), microcytic anemia (83%), pulmonary embolism anticoagulation (83%), and atrial fibrillation anticoagulation (80%). Topics requiring a face-to-face hematology visit included: abnormal bleeding (100%), polycythemia (75%) and other venous thrombosis (57%).

Patient Impact: The average response time to eConsult was 12 hours, compared to average time between eConsult and in-person hematology visit of 50.21 days. The majority of queries, 63%, were resolved via eConsult alone, avoiding a visit to hematology. The total round trip mileage saved by these eConsults was 18,933.6 miles.

Discussion: Despite lack of in-person evaluation, eConsultants were able to resolve the majority of cases encountered during the study period. Our results demonstrate that eConsults increase patient access to timely specialty care while reducing unnecessary face-to-face visits. These findings elucidate potential topics for further provider education, as well as support the continued development of eConsult programs in health systems across the country.

Poster #16

Deep Learning for Intestinal Capsule Image Analysis

Michelle Yeghyayan, Sana Syed, Mohammad Al-Boni, Timothy Emerick, Marium Khan, Kamran Sadiq, Najeeha T. Iqbal, Christopher A. Moskaluk, S.Asad Ali, Sean R. Moore, Guillermo J. Tearney, Donald E. Brown

Machine learning refers to a computer designing models or algorithms based on data measurements to complete various tasks. This approach to gathering, synthesizing, and utilizing mass amounts of data has groundbreaking potential when applied to the field of medicine, especially when considering the technique of Deep Learning. Deep Learning is a technologically advanced technique that makes use of a machine's complex neural network to analyze data and make judgments based on its analysis. These advancements aim to supplement and improve – rather than replace – the care a physician can provide his or her patient. As we develop more advanced Deep Learning convolutional neural networks (CNNs), we hope to expand our use of these algorithms into providing video image analysis, which is especially important for the data obtained via capsule endoscopy.

Capsule endoscopy (CE) is a procedure designed to image the gastrointestinal tract in a non-invasive, well-tolerated manner. A PillCam is swallowed by the patient, and as it travels through the GI tract via natural peristalsis, it captures photographs which are then sent to the data recorder worn by the patient. In CE procedures across many patients, there is a mass amount of data collected that is a perfect candidate for designing a CNN for diagnosis. We will be using the CE data collected at the University of Virginia and applying it to our Deep Learning algorithm. Our main goal is to use Deep Learning to identify features of interest in the videos. As the algorithm improves, we hope to apply it to aid diagnosis of enteric infectious diseases, a crucial issue in child health globally. We hypothesize that by synthesizing data from our patient pool, a carefully-designed deep learning convolutional neural network (CNN) can identify abnormalities in images collected from a capsule endoscopy with as much accuracy as a trained physician.

Poster #17

Cerebellar neuronal activation in neonatal hypoxia-ischemia

Chunzi Song, Jennifer Burnsed, MD

Perinatal hypoxia-ischemia (HI) is a significant cause of brain damage and lasting neurological deficits, and severe HI can lead to neonatal hypoxic-ischemic encephalopathy. However, the cellular events and circuits of activation involved in this injury are not fully understood. In particular, conflicting data exist regarding the role of the cerebellum, with some evidence for the preferential protection of this highly metabolically active area, and others suggesting that it is also injured by HI. This study explores the injury response of the cerebellum using cellular activation, as measured by expression of an immediate early gene, c-Fos. Hypoxia and ischemia treatments were carried out on postnatal day 10 (p10) mice using the well-established Vannucci-Rice model for hypoxic-ischemic encephalopathy, modified for mice. Identification and visualization of activated cells were accomplished using the Targeted Recombination in Active Populations (TRAP) technique to label activated cells with fluorescence, and the CLARITY procedure was used to remove lipids and achieve improved antibody penetration and immunostaining on the remaining brain tissue. Anti-NeuN antibody was used to stain for granule cells, the most populous cell type in the brain. In both experimental HI and sham mice, cellular

activation was higher in the cerebellar vermis than in the hemispheres, but we did not observe any visible difference between HI and sham groups. Based on cell morphology, a variety of cell types were likely activated, including granule cells, Purkinje cells, and glia. Colocalization data revealed a slight, but statistically insignificant, increase in the proportion of granule cell activation in HI mice, as compared to sham mice. Future extensions of this study include exploring other mouse models that more directly induce hypoxia and ischemia in the cerebellum, immunostaining for other cell types, and biochemical and gene expression studies to better define the role of cellular activation following hypoxic-ischemic brain injury. Since the neonatal cerebellum was found to be highly activated as compared to other parts of the brain, the TRAP and CLARITY techniques may also be particularly useful for further studies on normal cerebellar development.

Poster #18

Quantitative Analysis of Partial Nephrectomy Procedure on Devascularized Renal Parenchyma

Calvin Dorsey

Introduction/Purpose: A small renal mass (SRM), is a solid tumor, less than 4cm, that is suspicious for renal cell carcinoma. Partial nephrectomy (PN) removes the SRM while also preserving kidney function. Inevitably, there is normal renal parenchyma removed during the surgical removal of a SRM. The amount of devascularized renal parenchyma (DRP) impacts renal function recovery after surgery. In this study, we sought to determine the impact of DRP on postoperative glomerular filtration rate (GFR) after treatment of SRM with PN.

Materials and Methods: We performed a retrospective analysis of 232 patients treated with PN at the University of Virginia between 2011 and 2018. Patients without contrast-enhanced imaging or those with a mass larger than 7 cm were excluded. Preoperative scans within 6 months and postoperative scans within 12 months of the procedure were used for analysis. Using 3-dimensional imaging software, preoperative and postoperative renal parenchyma and mass volumes were calculated. DRP was calculated by subtracting the postoperative renal parenchymal volume from the preoperative renal parenchymal volume. R.E.N.A.L. nephrometry score (RN) was also calculated. Regression models were used to examine the relationship between DRP and GFR.

Results: 89 patients met the study criteria; There were 57 males (64.0%) and 32 females (36.0%) with a mean age of 54.1 years old (SD $\pm$ 14.0). Mean Body Mass Index was 30.3 kg/m² (SD $\pm$ 7.44). Mean Charlson Co-morbidity Index was 2.7 points (SD $\pm$ 2.20). 68 patients (76.4%) had T1a tumors with 21 patients (23.6%) having stage T1b tumors; Mean renal mass diameter was 3.13 cm (SD $\pm$ 1.39). Warm, Cold, and Off-Clamp Ischemia techniques were used in 47, 33, and 7 of the cases, respectively, for a mean clamp time of 29.4 minutes (SD $\pm$ 20.9). Mean DRP volume was 26.5 cm³ (SD $\pm$ 25.8) which represented 15.7 % of the preoperative renal parenchymal volume. GFR values fell by an average of 9.6% (SD $\pm$ 20.3) at 6-month follow up. There were 0 local recurrences found in the postoperative period. Three independent variables showed statistically significant effect on percent of DRP: mass volume (β = 0.2), p <0.001), clamp time (β = 0.21, p = 0.04), and mean total RN score (β = 2.58, p = 0.007). Ischemia technique did not impact percent of DRP (β = 0.69, p = 0.84). Increasing percent of DRP also significantly correlated with percent of GFR decline (β = -0.333, p =0.021).

Conclusions: Our study shows that increased percentage of DRP after PN treatment is significantly linked to a decrease in change in 6-month GFR. There is a significant positive correlation between percent of DRP and mass volume, mean total RN score, and clamp time. Even though GFR values decrease postoperatively, the decline in kidney function must be weighed against the risk of cancer spread. Our study shows no local recurrences in patients with a SRM treated with PN. Therefore, PN is an effective nephron-sparing approach to manage the oncologic risk of a SRM.

Poster #19

Development of a clinical risk calculator for late-onset sepsis in very low birth weight infants

Katie Berry, Brynne Sullivan, MD

Background: Late-onset (>72 hours after birth) sepsis (LOS) causes significant morbidity and mortality in the very low birth weight (VLBW, birthweight <1500g) infant population of the NICU. The incidence of LOS is 1 in 5 VLBW infants but prevalence of sepsis workups and empirical administration of antibiotics is even higher, creating implications for development of antibiotic-resistant pathogens and complications in microbiome development. A web-based algorithm exists for early-onset-sepsis (EOS) prediction in late preterm and term infants, which demonstrated decreased use of empirical antibiotics without adverse outcomes.

Objective/Hypothesis: Develop and validate a multivariable model to predict LOS risk using a large cohort of VLBW infants.

Methods: LOS evaluations were identified for all VLBW infants admitted to the UVA NICU during 2012- 2014. Demographic, perinatal, and clinical data were obtained from the electronic medical record using chart review. For each infant, all culture-positive evaluations, or the first culture-negative evaluation, were cataloged and categorized by diagnosis. Twenty clinical variables were recorded including laboratory, flowsheet, and progress note data from a 2-day period preceding a blood culture drawn for LOS evaluation. Variables were chosen to capture both the baseline clinical status of the infant and the clinical changes prompting sepsis evaluation. Controls were selected from within the same cohort and matched on gestational age and postnatal age (+/- one week), excluding days during treatment with antibiotics for sepsis or other infections. The same 20 variables were recorded for controls using chart review of the 2-day period including the randomly generated, age-matched date.

Results: Out of 224 VLBW infants, 116 had at least one LOS evaluation that was cataloged and categorized, which identified 27 cases of septicemia, 1 meningitis, 18 clinical sepsis, 37 sepsis ruled-out, 10 necrotizing enterocolitis, 8 urinary tract infection, 5 pneumonia and 10 other infections. Preliminary analysis suggests a larger sample size is needed to develop and validate multivariable models.

Conclusion: Further data is needed to develop and validate risk prediction models. The event rate in this cohort will be used to determine further chart review necessary to generate sufficient numbers cases and controls. To increase sample size and improve generalizability, we began collaboration with research colleagues at Colombia University and Washington University in St. Louis and data collection at UVA is ongoing.

Poster #20**Activity preferences of people in the primary care waiting room**

John Kalmanek

With an ever-increasing focus on the importance of providing patient-centered care, healthcare teams must realize and make use of the opportunities they have to engage patients beyond the appointment itself. One such opportunity is to make more active the time that the patient and/or accompanying person spends waiting in the clinic. Over the previous decade, several innovations have been designed and implemented to make waiting time in the clinic a more active process, but little data exists to suggest which activities people would be most interested in doing while waiting. To better understand the perspectives of people waiting in the clinic (both patients and the people accompanying them), we developed and implemented a survey in the waiting room of the UVA Family Medicine Clinic. The survey incorporated a Likert scale to gauge participants' interest levels in doing a variety of different types of activities while they wait in the clinic, in addition to collecting both their demographic and situational characteristics to assess potential patterns in activity preferences. 93 people filled out the survey, and the activities with the highest mean interest levels on the 5-point Likert Scale (1 being "not interested at all" and 5 being "very interested") were "read about a health topic that is important to me" (mean=3.99) and "Do an activity that helps to relax me" (mean=3.94). The two activities that the highest percentage of people receiving care (n=63) were "very interested" or "moderately interested" in were "Read about a health topic that is important to me" (73%) and "Organize questions and concerns for my appointment" (70%), whereas for people not receiving care, the top two activities by percentage of people "very interested" or "moderately interested" were "Read about a health topic that is important to me" (76%) and "Do an activity that helps to relax me" (72%). These findings suggest that while on an individual basis people differ regarding the activity they are most interested in, there are several activities that a significant majority of people have interest in doing while waiting. A number of these activities that generated significant interest have low implementation and running costs, making them feasible options for healthcare teams looking for ways to make the long waiting times in clinic more active.

Poster #21**Eyes on Art: Engaging medical students with persons with dementia in the art museum**

Meredith Johnson MS4, Marcia Childress, PhD

Purpose: Many students enter medical school with preconceptions of persons with dementia which can interfere with appropriate care of a growing population. Experiences for medical students with persons with dementia and their caregivers outside of clinic or hospitalization allows a unique perspective on the daily life of a person with dementia and an opportunity to humanize patients who are frequently misunderstood.

Methods: Seven medical students at the University of Virginia, School of Medicine were recruited to attend the Eyes on Art workshop at the Fralin Art Museum with persons with dementia and their caregivers. Only one student attended each workshop to enhance student involvement in the workshop. Prior to and following the workshop, a survey including the validated Dementia Attitudes Scale (DAS) was administered. Additional questions inquired on the benefit of the experience to medical students and to themselves.

Results: Of seven participants, six completed the pre-survey (100.0%) and five completed the post-survey (83.3%). Unpaired t-test showed an increased agreement score in response to reward in working with persons with dementia (4.83 to 6.60 p=.013, 1=strongly disagree, 7=strongly agree). While 50% of students reported frustration in working with persons with dementia in the pre-survey, 20% expressed the same concern after the intervention. Of note, all participants reported some prior experience with persons with dementia, mostly in the medical context. Most importantly, all respondents to the post-survey agreed the program provided benefit for students.

Conclusion: Medical students site benefit after art museum workshop with persons with dementia and their caregivers. Despite clinical experience with these patients, students showed significant changes in their comfort with persons with dementia as well as personal reward from such interactions. This is confirmed by responses to the DAS as well through free response. This study is limited by small number of participants at a single institution and the potential widespread impact of this program remains to be seen. Eyes on Art will continue to invite medical student participants as an optional part of the medical school curriculum.

Poster #22

Dual-Modality Breast Tomosynthesis Reader Study

Catherine Zisk, Dr. Mark B. Williams

Purpose: To assess the diagnostic performance of dual-modality tomosynthesis (DMT), which performs both digital breast tomosynthesis (DBT) and molecular breast tomosynthesis (MBT), as a breast imaging modality compared to 2D mammograms and breast tomosynthesis alone.

Materials and Methods: A clinical trial comparing DBT, DBT plus 2D mammography and DBT plus 2D mammography plus MBT to determine if the addition of MBT allows for more accurate detection of malignant and benign lesions. The study subjects were nonpregnant women over the age of 18 who were scheduled for a breast biopsy. They underwent a DMT scan before their scheduled biopsy. All subjects provided informed consent. Seventy five subjects were enrolled in this study, providing a total of 83 biopsied lesions. The MBT reconstructed images were read by a nuclear medicine radiologist who was blinded to any clinical information about the subjects. The nuclear medicine radiologist scored findings in terms of malignancy suspicion level using a 5-point scale. A second reader, who is an experienced breast radiologist, performed a separate blinded review using the same 5-point suspicion scale. The image set for each subject was reviewed in a single session, using the specific order of 1) DBT only, 2) DBT plus clinical 2D mammography (cFFDM), 3) DBT+ cFFDM+MBT. The clinical biopsy results of the lesions were used as ground truth and compared with the results of the two readers. An ROC analysis was performed comparing the reader rating for each individual lesion to the biopsy result which was used as ground truth. The ROC plots the true positive rate versus the false positive rate as the threshold in the suspicion scale determining the division between a positive finding and a negative finding is varied from 1 to 5. The area under the ROC curve (A_z) was calculated as a metric for overall diagnostic accuracy.

Results: The addition of MBT to DBT plus 2D mammography significantly improved area under the ROC curve. The A_z for DBT+ cFFDM was 0.74, while that for DBT+ cFFDM+MBT was 0.93 (p-value of 0.0011, with 95% confidence). The addition of MBT leads to an increase in the number of true positives and true negatives as well as a decrease in false positives and false negatives. The DBT+cFFDM results had 13 true positives, 42 true negatives, 13 false positives,

and 8 false negative out of the total 83 lesions. The DBT+cFFNM+MBT results had 20 true positives, 54 true negatives, 6 false positives, and 1 false negative out of the total 83 lesions.

Conclusion: This study shows that it is likely that the addition of MBT to a breast lesion diagnostic work-up can allow for more accurate diagnosis. The improvement in positive predictive value observed through the addition of MBT suggests that the rate of unnecessary breast biopsies might also be reduced.

Poster #23

Secure messaging through PositiveLinks: examination of electronic communication in a clinic-affiliated smartphone app for patients living with HIV

Sabrina Swoger, Tabor E. Flickinger, Marika Grabowski, Karen Ingersoll, Rebecca Dillingham

Purpose: The use of secure health messaging may be valuable in the ongoing management of patients with chronic illness. One platform for connecting patients living with HIV to their care team is PositiveLinks (PL), a clinic-affiliated smartphone application with a secure messaging feature. This study investigated how the PL secure messaging feature was used: who was messaging, the types of content exchanged, and the functions these messages served.

Methodology: Qualitative analysis of PL messages from November 2017 through January 2018 was performed. Messages were coded by the type of user (PL staff, patient, or provider), the topics of messages, and the functions of messages. Message topics were categorized into app-related, medical care, and/or social needs. Messages served the functions of information exchange and/or rapport-building.

Results: 1474 PL messages were analyzed. Of these, 44% were sent by PL staff, 38% by patients, and 18% by providers. Patients received the most messages, at 61%, followed by providers at 22% and PL staff at 17%. Message topic analysis showed that 57% of messages related to the PL app, followed by medical care at 34.3% and social concerns at 12.4%. Regarding function, 87.3% of messages contained information exchange, and 33.8% of messages contained rapport-building. Messages that contained rapport were most likely to be sent by providers (54.8%). Messages sent by patients were most likely to be related to their medical care (49%).

Conclusion: The use of a secure messaging system provided the opportunity for patients and care providers to strengthen their relationship, both through responsiveness to concerns and rapport-building. Accessible communication also enabled coordination of medical and social needs. Implementation of secure messaging through clinic affiliated smartphones could improve patient-centered care between visits.

Poster #24

IL1 signaling in endothelial cells is atheroprotective by inducing beneficial endothelial to mesenchymal transitions during late-stage murine atherosclerosis

Richard A Baylis, Xenia Bradley, Gary K Owens

Despite decades of research, our understanding of the factors and mechanisms controlling the stability of late-stage atherosclerotic lesions remains poor. One proposed mechanism to increase plaque stability is to inhibit inflammation. Indeed, the potent inflammatory mediator,

interleukin-1 β (IL1 β), is believed to be a key driver of plaque pathogenesis. IL1 β is thought to impart these effects in multiple ways, including inducing proinflammatory changes in vascular endothelial cells (EC); however, the effect of eliminating IL1 signaling in EC during atherosclerosis development remains uncertain. Based on the current literature we hypothesized that loss of IL1 signaling in EC throughout atherosclerosis formation would result in beneficial changes to late-stage lesion stability, including reduced macrophage accumulation, increased collagen content, and reduced number of endothelial to mesenchymal (EndMT) transitions, a process that is stimulated by IL1 β whereby EC downregulate their characteristic markers and acquire a mesenchymal phenotype. Importantly, the rate of EndMT has been shown to correlate with reduced lesion stability in human lesions. To test this hypothesis, we generated Cdh5-ER^{T2}Cre IL1R1^{fl/fl} R26R eYFP Apoe^{-/-} mice, allowing for simultaneous EC lineage tracing and EC-specific loss of IL1 signaling, and fed them 18 weeks of high fat diet to induce advanced atherosclerotic lesions. We found no effect on lesion size, but an unexpected reduction in collagen content, suggesting reduced lesion stability. In addition, high resolution confocal analyses of lesions revealed that EC-specific loss of IL1 signaling induced detrimental changes in the cellular composition of the lesion, including a significant increase in the number of Lgals3+:Acta2+ cells, which are markers of macrophage and SMC, respectively. We also found that a large number of EC delaminated from the lumen monolayer and invested within the lesion, suggesting that EC may play a much more important role in lesion pathogenesis than by simply maintaining the lumen monolayer. The number of EC that invested within the lesion was unaffected by loss of IL1 signaling. Interestingly, the EC that invested began to express multiple non-characteristic genes, including mesenchymal markers consistent with EndMT, but also macrophage markers. Importantly, we found that significantly fewer EC began to express the mesenchymal marker, Acta2, which is consistent with literature showing that IL1 β induces EndMT *in vitro*. Altogether, these data suggest that the loss of IL1 does not alter the ability of EC to invest within lesions, but significantly impacts their phenotypic transitions within the lesion. These data are the first to demonstrate that EndMT may be a beneficial process in atherosclerosis and suggest that identifying therapies that augment EndMT may represent a novel strategy to treat patients with advanced atherosclerosis.

Poster #25

Use of Machine Learning in the Development of Automated Stroke Detection

Garrett Simkins, Mark McDonald, Omar Uribe, Katelyn Salotto, Yan Zhuang, Gustavo Rhode, and Andrew Southerland

Introduction: Early identification and treatment of stroke is associated with improved outcomes. Pre-hospital screening tools aid in identification of stroke, but the utility of these tools is limited by inconsistent training and implementation. The use of computer algorithms provides the opportunity for reliable and standardized evaluation of suspected strokes. Computer algorithms may also be useful in identifying acute stroke with large vessel occlusions (LVO), which are eligible for thrombectomy in select hospitals. The current, ongoing project aims to use machine learning to develop an algorithm capable of accurate, automated stroke detection. Such an algorithm could be implemented in portable devices with a user-friendly interface, aiding in prompt recognition and treatment.

Methods: Data is being collected from healthy controls, stroke patients with deficits of interest, and patients acutely screened for stroke. Participants are recorded performing a short series of neurological maneuvers, with focus on limb drift, coordination, facial weakness, gaze deviation, and abnormal speech. Relevant components will be extracted from the video using open-source

algorithms for computer vision. A Linear Discriminant Analysis predictor model will classify the extracted data as normal or abnormal. The output of the algorithms will then be used to differentiate stroke mimic from acute stroke without LVO from acute stroke with LVO.

Results: The current study is ongoing, as is collection of video data. A pilot study developed a predictive model that assessed facial weakness in static images. The model identified pathological facial weakness, classified by two senior neurology residents, with 94.6% sensitivity and 96.8% specificity. Overall accuracy was 94.6%.

Conclusion: The pilot study indicates that the method for identifying pathological facial weakness in static can be accurate. A similar model will be used to analyze video footage, and present the user with reliable detection of stroke. Successful implementation of this software would provide a user-friendly interface that enables pre-hospital evaluation of potential stroke and facilitates an optimal care timeline.

Poster #26

Evaluation of the Current State of Blood Pressure Measurement in a UVA Primary Care Setting

Lauren Adams

The diagnosis and treatment of hypertension depends on accurate measurement of blood pressure (BP). Given the 2017 lowering of target BP by the American College of Cardiology, the detection of small differences has become even more important. However, BP reading is one of the most inaccurately performed measurements in clinical medicine. The purpose of this study is to assess the current state of BP measurement techniques in a UVA primary care setting in order to identify potential areas of improvement. Between the dates of May 28 – August 31, 2018, nurses in a UVA primary care setting were observed as they measured patients' BP. During the observation of the rooming process, specific techniques used when taking a patient's BP were noted. The factors selected were based on the most commonly used guidelines and include the amount of time patient was seated, patient's body position, silence by patient and nurse during measurement, and appropriate cuff size and positioning over bare skin.

Of the BP measurement techniques observed, the techniques that were most likely to be done incorrectly include 5 minutes of rest (95% failure to complete), arm support (67% failure to complete), and cuff at heart level (66% failure to complete). The average time to BP measurement was 2:14 minutes with a standard deviation of 1:31 minutes. Only 5% of measurements were taken once the patient had been seated for at least 5 minutes. An insufficient rest period results in increases in systolic and diastolic BP. In 28% of observations, BP was appropriately measured with patients' arm supported at the elbow. In 53% of observations, however, BP was taken while the patient was holding onto the handle of a cart that was positioned in front of them. Failure to support the arm at the elbow, even when it was positioned perpendicularly to the torso, leads to an increase in systolic BP and diastolic BP. In 31% of observations, patient's BP was appropriately measured with the BP cuff at heart level. 13% of BP measurements were taken with patient's arm too low, while 53% of BP measurements were taken with patient's arm too high. When the BP cuff is lower than heart level, systolic and diastolic BP are increased. Conversely, when the BP cuff is higher than heart level, systolic and diastolic BP are decreased.

While pressure to room patients quickly and efficiently may make it difficult to wait the recommended 5 minutes, two areas that can be easily improved upon with training and education are arm support and cuff positioning. Correcting these two techniques can have clinically and statistically significant effects on measured BP.

Poster #27

***Enterobacteriaceae* Blooms in the Premature Intestine**

Sahitya Allam

Background: Neonatal infections are associated with severe morbidity and mortality in preterm infants. In case-control studies, dysbiosis of intestinal microbiota has been recognized as a risk factor for these events. Often, an increase or “bloom” of bacteria species within the family *Enterobacteriaceae* (ENT) is observed preceding the event. The frequency with which these blooms occur in individual patients and the clinical factors associated with these ecological changes have not been well characterized.

Methods: In a prospective cohort of premature infants <32 weeks gestational age and birth weight <1500g, daily stool samples were collected. Samples were frozen at -80C. DNA was extracted at intervals ranging from 3-7 days from stool using a Zymo Fecal Microbe Miniprep kit with modified enzyme and mechanical lysis steps according to the standard IGS protocol. Bacterial populations were quantified using a SYBR-green based quantitative qPCR assay. Total bacterial load was measured using universal 16s rRNA primers and ENT load was measured using previously designed nitrate reductase (*narJ*)-specific primers. A standard curve was generated using known quantities of the *Enterobacteriaceae* strain 042. Clinical metadata were collected from the electronic medical record.

Results: Samples from 17 infants with a mean gestational age of 25.8 wks and birth weight 909 g were analyzed. Eight patients (47%) had an observed bloom event during the first 60 days of life. Blooms were associated with the following clinical events: bacteremia (1 of 8 cases), urinary tract infection (1 of 4), and necrotizing enterocolitis (2 of 3). To evaluate factors associated with changes in ENT, 108 week-long intervals from all infants were evaluated. Withholding of enteral feeds (NPO status) was the only clinical factor associated with an increase in relative ENT (mean pre 2.8% vs post 14.2%, $p=.03$). Other factors including antibiotic exposure and fortification of breast milk were not associated with changes in ENT abundance. Additionally, higher resolution sampling was obtained for a total of 11 patients, in which the majority of blooms demonstrated minimal stochastic variation. Furthermore, newly collected data points at smaller, 3-5 day intervals showed an expected degree of consistency with the older, weekly data points.

Conclusion: This work has advanced our understanding of the clinical factors associated with *Enterobacteriaceae* blooms in premature infants. Future directions include expanding the analysis of clinical factors with higher resolution *Enterobacteriaceae* abundance data and investigating whether modifying the gut microbiome could protect against disease in premature infants.

Poster #28**Improving Oral Health Practices among Latinos in Charlottesville**

Jasmine Ragoowansi (MS2), Amy C. Brown MD, Abigail Kumral MD

Introduction: Poor oral health is a pervasive problem within the Latino-American community and has been linked to several adverse health outcomes in children. Several cultural and socioeconomic factors such as a lack of dental health education, transportation, language difficulties, and limited access to dental insurance often act as barriers to preventative and curative care.

Objective: This multi-faceted study sought to characterize and subsequently address these barriers within a largely underserved, predominantly Spanish-speaking, mobile home community in Charlottesville through both community-based and clinic-based interventions.

Methods: This study had a three-part outreach initiative: a baseline community survey, three community educational outreach events, and the creation of several dental referral resources that were made available to pediatricians in all three of UVA's pediatric primary care clinics to aid physicians working with Spanish-speaking patients with limited access to dental care.

Results: Survey results revealed that over 79% of participant's children had some form of dental insurance. While approximately 91% of children reported brushing their teeth at least 2 times a day, just over half (53%) reported flossing at least once per day. Several participants listed difficulties with transportation or a lack of access to a dental office carrying their specific insurance as barriers to care. Interventional education events were well attended and provided important information on proper oral hygiene practices and resources on dentists in the area that met specific needs of the community. Pediatricians were given access to a "dot phrase" referral list and were educated on the importance of recommending regular dental care to their patients starting at a young age.

Conclusions: This project successfully brought the importance of dental health to the attention of Southwood community while also collecting data on their current knowledge and behavioral health practices regarding oral health. By partnering with existing community organizations, targeted educational interventions were well received and will create a basis for on-going, sustainable outreach within the community.

Poster #29**Patient Attitudes Regarding Discussion of Religion and Spirituality with PCP in Setting of Chronic Illness**

Alex Paap and Kristen Wells, MPH, PhD

A screening spiritual history is a short, structured questionnaire that health professionals can use to identify patients' spiritual values and beliefs during a medical interview. We report patient attitudes towards their primary care provider performing screening spiritual histories in the setting of chronic illness. Patients were systematically approached in the waiting room of a family medicine clinic to complete the survey. In addition to assessing attitudes towards screening spiritual histories, the questionnaire also assessed chronic disease burden, religiosity, and demographics. 90 participants completed the survey. Preliminary analysis has revealed that 34% of patients either strongly agreed or agreed that their PCP should take a screening spiritual

history, compared to 18% of participants who disagreed or strongly disagreed and 41% who were neutral. Few participants indicated that they would meet a screening spiritual history with resistance (7%), with the remaining participants indicating they would respond with acceptance (30%), appreciation (25%), indifference (15%), or puzzlement (13%). A not-insignificant proportion of participants indicated that it would increase their trust in their primary care provider if they completed a screening spiritual history (25%). Responses indicated that patients largely desired discussion of religion or spirituality for reasons of holistic understanding rather than for prayer or to change medical management.

Poster #30

Exercise Counseling for Older Adult Patients in a Primary Care Setting

Nikki Floyd

Background: The link between physical activity and reduced morbidity risk is well established, and though older adults are more likely to receive exercise advice from their physicians than younger age groups, older adults still demonstrate the lowest physical activity levels.

Aim/design: The purpose of this review is to compare the current literature on efforts to incorporate exercise counseling into primary care practice against the literature on older adult attitudes toward exercise in order to 1) assess the challenges to incorporating exercise counseling in general and 2) identify ways in which physician advice might be tailored to the older adult population in particular for better results.

Discussion: Research promoting physical activity counseling in clinical practice acknowledges a number of challenges, such as lack of provider time, skill, and reimbursement, but provides potential solutions as well, including brief assessment methods, training through graduate and continuing medical education, and policy-based interventions. Taken together, studies on older adult attitudes toward exercise reveal both trends and tremendous diversity. Some older adults believe physical activity to be unnecessary, intimidating, or even harmful while others associate it with successful aging. Older adults may also differ greatly in their exercise goals, motivators, and even in their very definition of physical activity. For many, cost, location, and marketing theme of the exercise program were major determinants of interest.

Conclusion: In addition to overcoming the many challenges to incorporating exercise counseling into primary care in general, physicians may also need specialized knowledge to counsel older adults. Physician-delivered exercise counseling for older adult patients may be more effective if the physicians are familiar with specific barriers and motivators to exercise commonly perceived by older adults. Although older adult attitudes toward exercise are diverse, specific knowledge of this diversity will aid physicians in guiding these patients through the stages of change and leading them to the most appropriate values- and needs-matched exercise programs.

Poster #31**Knowledge about Hereditary Hemochromatosis: A Survey of Primary Care Physicians**

Caleb Southall

Hereditary Hemochromatosis (HH) is an autosomal recessive, 1% penetrant, variably-expressive genetic disease of iron storage and metabolism. HH is most prevalent among individuals of northern European ancestry. Primary care physicians (PCPs) will likely come across at least one case of HH while practicing medicine in the United States. As such, PCPs play an important role in screening for HH. However, knowledge of HH among PCPs has been shown to be inadequate. This study seeks to survey PCP knowledge of the pathophysiology, population genetics, and clinical diagnosis of HH. A blind survey consisting of 9 multiple choice questions was administered to UVA PCPs. Based on the limited data obtained, baseline knowledge of HH among UVA primary care physicians is good given the relatively low prevalence of the disease. However, there is some misunderstanding regarding the genetic etiology of HH.

Poster #32**Going Digital: Implementing an Electronic Medical Record in Hospital Nacional “Jose Felipe Flores”, Totonicapán, Guatemala**

Nicholas Aldredge

The adoption of electronic health records (EHRs) in developing nations has progressed slowly due to the lack of adequate infrastructure, funding, and training. However, EHRs have been successfully implemented previously in resource-limited health systems in South Africa, Haiti, Cameroon, Kenya, and Peru. Detailed, organized, and easily accessible medical records are particularly important in emergency departments due to the volume and acuity of the patient population. In order to further study the plausibility of an EHR in a resource-limited emergency department, a web-based, Spanish-language EHR known as SABER was developed for use in Hospital Nacional “José Felipe Flores” in Totonicapán, Guatemala. The software collects patient data concerning demographics, triage, initial evaluation, review of systems, physical exam, and evaluation and plan. It then generates a .pdf file consistent with information requirements of the Guatemalan Ministry of Health. Local physicians, medical students, and nurses were trained in the use of the software, which debuted in July 2016. In order to assess the effectiveness of SABER as an EHR, 6 “think out loud protocol” focus groups and a 5- and 7-point Likert survey were conducted with 6 physicians and 31 medical students working in the Hospital Nacional emergency department. Results indicate overall satisfaction rates of 4.4/5 and 4.1/5 among doctors and medical students respectively. Positive aspects identified by staff include ease of use, quick data entry, and the potential for large-data research. Remaining challenges include incorporating electronic nursing orders and lab results, technology troubleshooting problems including printer difficulties, a lack of electronic signature capability, and lack of integration with the rest of the hospital. Our results indicate that introducing EHRs to developing nations presents an opportunity to reduce health disparities between nations through improved patient records and medical data collection.

Poster #33

A New Clinically Based Model to Evaluate Biointegration of Acellular Dermal Matrices in Post-Mastectomy Patients

Kendall Bielak

Background: Acellular dermal matrices (ADMs) have modernized alloplastic implant-based breast reconstruction in post-mastectomy patients. There are several ADMs currently available for clinical use that differ in species of origin, decellularization processes, and sterility techniques. The effects of these variables on integration of the ADM into the host and the subsequent clinical outcomes have not been fully investigated. The complete evaluation of these grafts requires a model that recapitulates the microenvironment of the surgical space, as well as clinical scenario of post-mastectomy patients, including the deleterious effects to the soft tissue of radiation therapy. The focus of this study is to utilize a new model developed in our lab to evaluate the dynamic process of biointegration (neovascularization, inflammation, and tissue remodeling) of a porcine based ADM, in real time. This ADM is hypothesized to improve biointegration through its natural tissue structure, while providing durable soft tissue augmentation.

Methods: Scanning electron microscope images were made of the ADM to evaluate the microstructure of the construct. Next, 16 C57/b6 mice were randomly split into two groups. The dorsal skin on group 1 received 35Gy of ionizing radiation and group 2 did not receive radiation. Utilizing the dorsal skin fold window chamber model, samples of ADM were placed directly onto a fascial vascular plexus exposed through de-epithelialization and covered with a transparent coverslip immediately, or 12 weeks post-radiation. Photographs and photoacoustic microscopy (PAM) of these chambers allowed for real-time, noninvasive assessment of oxygen saturation in living tissues while also visualizing new microvasculature growth within the ADM over the course of 21 days. At day 21 the wound bed and ADM were sectioned and analyzed for CD31, vimentin, and smooth muscle actin as well as inflammatory (M1) and regenerative (M2) macrophages.

Results: This model had a terminal point of 21 days due to re-epithelization obscuring visibility from the dorsal chamber that coincided with the ideal clinical time point for surgical drain removal. Serial PAM imaging visualized and quantified the investment of nascent microvasculature and oxygen saturation within the ADM as a function of time. Endothelial (CD31) staining at the terminal time point was used to confirm the PAM vascular analysis. Vimentin (fibroblast marker) and alpha-smooth muscle actin expression within the ADM was used to more accurately describe the tissue remodeling. The impaired healing ability of irradiated epithelium in this model was confirmed by immunohistochemical evaluating of macrophages which confirmed a suppressed immune response with predominant M2 macrophage invasion suggesting a phenotype of tissue regeneration and remodeling rather than inflammation (M1).

Conclusion: This model has the ability to recapitulate the post-radiation microenvironment and clinical scenario of implant-based breast reconstruction in post-mastectomy patients to better evaluate mechanisms and rates of biointegration of ADMs and determine the features key to improved clinical outcomes.

Poster #34**Primary Care Physician Volunteerism and Job-Related Attitudes**

Micah Brickhill-Atkinson

Purpose: Physician burnout is a critical issue in the medical profession that has triggered a search for evidence-based interventions. While qualitative studies have suggested benefits of volunteering, its quantitative effect on physician burnout has not been investigated. The research team developed a survey to assess the variation of job-related attitudes with different primary care physician volunteerism practices.

Methods: An online survey was emailed to University of Virginia Family Medicine and General Internal Medicine faculty physicians and residents. Burnout was assessed using the Maslach Burnout Inventory Health and Human Services Survey (MBI-HSS), which is a validated tool for quantifying job-related attitudes. The MBI-HSS separately assesses three components of burnout: emotional exhaustion, depersonalization (i.e. unfeeling and impersonal responses toward others), and diminished feelings of personal accomplishment. The research team also collected demographic information and asked respondents' frequency of volunteering (e.g. never, once a month, once a week) in various categories (e.g. non-medical, medical). Thirty-three complete responses were collected, and three were excluded because of uninterpretable answers.

Results: Overall, burnout scores and volunteerism did not exhibit a frequency-dependent linear relationship. Participants who volunteered once a month showed lower emotional exhaustion and depersonalization compared to groups who volunteered more or less.

Conclusions: Volunteerism's benefits have been qualitatively established in the literature, but whether it protects against physician burnout remains a topic for further research. We found that participants who volunteered once a month had lower emotional exhaustion and depersonalization compared to those who volunteered at higher and lower frequencies, which could suggest that an intermediate level provides optimal benefits to the volunteer. Future work should attempt to identify causality through measuring burnout before and after a volunteering intervention.

Poster #35**Identification of Bloodborne Pathogens in Cases of Acute Febrile Illness in Sudan: A Follow-up to the Typhoid Surveillance in Africa Program (TSAP)**

John Wieser

The Typhoid Surveillance in Africa Program (TSAP) was established in 2010 by an international group of collaborators for the purpose of characterizing the epidemiology of invasive *Salmonella* disease in Sub-Saharan Africa using microbiological methods (i.e. blood culturing). Compared to most other sites in the study, neither *Salmonella typhi* nor invasive non-typhoidal *Salmonella* disease were identified in the East Wad Medani site in Sudan. As blood culturing is believed to have a sensitivity lower than that of molecular detection methods such as qRT-PCR, the Hout Lab developed a custom TaqMan Array Card for the purpose of bloodborne pathogen detection. Total nucleic acid extracted from whole blood samples was analyzed using this novel array card to characterize the pathogen(s) present in the blood of patients presenting with acute febrile illness at the Sudan surveillance site. Positive results were further confirmed via a secondary

PCR amplification and subsequent Sanger sequencing, either direct or following plasmid integration depending on amplicon size. Using a C_t cut-off of 35.0, we had positive hits at 18 different targets by TaqMan Array. These results showed high rates of *Plasmodium*, mostly *P. falciparum*, with *Dengue*, *E. coli*, and *K. pneumoniae* being the next most prevalent targets. There was no detection of *Salmonella* species by PCR, which is consistent with the culture results of the initial TSAP study. Overall, pathogens were detected in 88/155 valid samples (57%) with 105 positive hits. Detections were mostly malaria (72/105 positive hits, 69%) with 33/105 positive hits (31%) other causes. This study has shown that molecular diagnostic methods utilizing TaqMan Array PCR are a valuable tool that can be applied to detect causes of acute febrile illness in epidemiological surveillance studies worldwide and help to guide implementation of larger public health measures.

Poster #36

β -catenin and Immune Cell Expression in Mismatch Repair Deficient Endometrial Carcinomas

Margaret B. Rowe, BS, Anne M. Mills, MD, Kari L. Ring, MD, MS

Dysregulation of the Wnt/ β -catenin pathway is an important driver of carcinogenesis in some endometrial tumors and is a predictor of worse progression-free survival. Such tumors may require more aggressive therapy. Little is known about the role of Wnt/ β -catenin pathway activation on mismatch repair (MMR) deficient tumors that traditionally are considered good candidates for immunotherapy. This study looks at immunohistochemical expression of β -catenin, indoleamine 2,3 dioxygenase (IDO), and PD-L1 in a set of MMR deficient tumors. Six tumors in our set of 62 (6/62, 9.7%) demonstrated nuclear β -catenin localization indicative of Wnt/ β -catenin pathway upregulation. Four of the nuclear β -catenin staining tumors were Lynch syndrome-associated (4/23, 17.4%), one was *MLH1* methylated (1/20, 5%), and 1 was MMR intact (1/19, 5.3%). Of the 4 Lynch syndrome-associated tumors, 1 tested positive for a germline variant in *PMS2* and the other 3 tested negative for germline mutations but showed a pattern of MMR gene loss on immunohistochemistry suggestive of Lynch syndrome. Tumors with nuclear β -catenin expression were more likely to show tumoral PD-L1 expression than tumors without nuclear β -catenin expression (83.3% vs. 39.3% $p=0.04$). While tumors exhibiting microsatellite instability (MSI-H) have been shown to have increased immune cell infiltration, tumors showing upregulation of the Wnt/ β -catenin pathway have been shown to have decreased levels of immune cell infiltration. Our results suggest that immunohistochemical staining for nuclear β -catenin expression may be an appropriate screening tool to identify a subset of MSI-H tumors that may be less responsive to immunotherapy.

Poster #37

Paying a Premium: Drivers of the Cost of Insurance in the Individual Marketplace

Deson Haynie, MHS, Chad Fletcher, BS, and B. Cameron Webb, MD, JD

Background: Recent years have seen tremendous increases in health insurance premium rates on the individual Affordable Care Act (ACA) marketplace. Not only are premiums increasing, but the rate of increase is incredibly variable from one region to the next, with Charlottesville among the highest rate increases in the nation. While various individuals have speculated as to the causes of these increases, often citing “legislative/regulatory uncertainty” as a significant factor, to the best of our knowledge no studies exist attempting to break down

and quantify those premium increases by their individual factors. The aim of the present study is to identify the drivers of health insurance premium increases in the state of Virginia and quantify the proportion of the increase due to each factor.

Methods: A literature review was performed to assess current beliefs regarding the drivers of health insurance premiums. Following the review and after consultation with a small team of experts, the following 6 key areas were determined to be those that most encompass the health insurance drivers: 1.) provider networks, 2.) market competition, 3.) patient risk pool, 4.) costs and payments, 5.) utilization of services, and 6.) government uncertainty. Data on premiums were then collected for all five years of the individual ACA exchange from CMS and the Virginia SERFF database. Demographic data were taken from the US Census Bureau. Insurer payment data were taken from Virginia Health Information (VHI). Other variables were collected from reputable sources, including the University of Wisconsin's County Health Rankings. Correlation coefficients were calculated for the variables considered.

Results: Preliminary results suggest a minor, but significant, correlation between premium charged and total paid by insurer for a given year (-0.226). Our findings also suggest that the correlation between premiums and the number of insurers in the area (market competition) is fairly negligible (0.081). This is contrary to what was seen in the first year of the exchanges. However, given that perceived impacts of "government uncertainties" may be different among insurers, this finding could suggest that insurers react differently to political turmoil.

Conclusion: Government uncertainty appears to be creating very real and significant increases in premiums on the ACA marketplace. State legislators should do more to regulate the increases in premiums and ensure that price increases are sufficiently justified. While many states have rigorous vetting processes and high scrutiny when it comes to increasing rates, the insurance bureau of Virginia does not currently have strict regulation of rates. Groups like the Virginia Bureau of Insurance should do more to reign in these costs with increased regulation and more rigorous requirements for rate change justification.

Poster #38

Middle Cerebral Artery Occlusion: A Reliable Animal Model of Ischemic Stroke

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Ischemic stroke is the most common subtype of stroke with poor prognosis. To investigate the mechanisms and new options for therapy, it is often necessary to turn to the genetically modifiable mouse model. The middle cerebral artery occlusion (MCAo) approach enables the induction of ischemic stroke in the murine model with good reproducibility. This method relies on insertion of a silicon-coated monofilament into the internal carotid artery (ICA) until the middle cerebral artery (MCA) branchpoint, triggering ischemia in the ipsilateral hemisphere. Depending on the duration of ischemic occlusion, the resulting infarction first affects the striatum and then it expands to involve the cerebral cortex. After the experimentally predetermined period of time, the monofilament can be removed so that reperfusion is achieved, mimicking the results of successful therapeutic interventions in humans including thrombectomy or recanalization. To determine the size of infarction, 2,3,5-triphenyltetrazolium chloride (TTC) staining is utilized for easy visualization of the stroked region in freshly dissected brain slices. Stroke volumes can

then be calculated following several published algorithms compensating for brain swelling in the ipsilateral cortex. In addition, we propose to compensate for the area of missing brain tissue due to the increased fragility of the infarcted region using a simple extrapolation. Researchers can utilize these calculations to measure the changes in infarct volume following experimental administration of pharmacological agents. The mouse model affords an excellent platform for identification of cellular and molecular therapeutic pathways that can be translated into clinical stroke practice.

Poster #39

Assessment of Internal and Family Medicine Residents' Perceived Preparedness to Manage Opioid Use Disorder

Margot Mellette

Background: Primary care providers (PCPs) are uniquely well positioned to effectively treat the growing number of patients with opioid use disorder (OUD) nationwide, but methods for doing so remain poorly integrated into general primary care practice. With physician training as a potential source of this problem, this study aimed to assess UVA internal (IM) and family medicine (FM) residents' perceived preparedness to identify and treat OUD.

Methods: A 31-question survey was administered during three IM resident business meetings in Spring 2018. A 29-question survey was administered during two FM resident curriculum conferences in Fall 2018.

Results: Responses were obtained from 43 of the 105 internal medicine residents (41% response rate) and 18 of the 24 family medicine residents (75% response rate). 82% of residents (86% IM, 72% FM) reported that they felt somewhat or very prepared to identify and diagnose a patient with OUD. 56% (49% IM, 72% FM) reported that they felt somewhat or very unprepared to treat OUD once identified. 77% (84% IM, 67% FM) rated the level of clinic support available to them for successfully referring a patient for SUD treatment as fair or poor. 69% (63% IM, 83% FM) rated the quantity of residency instruction on OUD as too little or none yet received and 52% (47% IM, 67% FM) rated the quality of residency instruction on all substance use disorders as fair or poor. None of the residents answered all six of the knowledge-based questions correctly. 39% (35% IM, 50% FM) correctly stated that patients with OUD who attain sobriety using an abstinence-based approach are *less* likely to maintain sobriety as compared to those who use opiate replacement therapy. 40% (16% IM, 94% FM) reported that they were somewhat or very likely to pursue outpatient primary care post-residency and 23% (7% IM, 61% FM) reported that they were somewhat or very likely to obtain buprenorphine certification.

Conclusions: While a significant majority of residents felt prepared to diagnose OUD, over half of the residents felt unprepared to treat OUD once identified. Residents cited a lack of clinic support, time constraints, and access to SUD treatments as major barriers to adequate care of patients with OUD. Additionally, over two-thirds of residents reported that they receive too little instruction on OUD during their residency training. Residents demonstrated both an interest and a clear need for enhanced training on OUD treatment, particularly as it pertains to the proven value of opiate-replacement therapy. Further research is needed to determine best practices for improving resident knowledge of OUDs and enhancing confidence in providing OUD treatment.

Poster #40

An Examination and Renovation of Learning Resources in the UVA Medical School Anatomy Curriculum

Gabrielle Smith

This project focused on improving the anatomy lab manuals for a 1st year anatomy course at the UVA Medical School, the Musculoskeletal and Integumentary System (MSI). Feedback about the pre-existing labs was received from the medical school class of 2021. Although the feedback was mostly positive, there were still areas in need of significant improvement. The objective of this project was to make the labs easier for students to use and study from, while still conveying the necessary material. To do this, three smaller goals were created.

First, more visuals, such as photographs and sketches, were incorporated in order to give students a clear understanding of what the anatomy looks like in a human body before coming to lab. Second, a clear distinction between the dissection instructions and additional learning objectives related to clinical applications was made. To do this, additional information from the lab manual, such as learning objectives about pathology, was removed. This information, while useful, can be distracting while trying to perform dissections in lab. Rather, we plan to present students with both a lab manual and a pre-lab. The manual contains the critical dissection instructions and images of the anatomy, while the pre-labs will contain additional relevant information about the structures being dissected. To accommodate students who wish to be presented with relevant pathology and function while in lab, the anatomy manuals were uploaded to a website allowing combination of different types of media. The lab manual information is presented on basic power point slides, and additional information, such as muscle actions and innervations, radiograph images, and videos of different tests, is made available by simply hovering one's cursor over various points on the slide. This provides students with the option of learning clinical applications of the structures while dissecting, or alternatively focusing on the techniques of the dissection and learning clinical applications at a later time. Finally, students were provided with additional opportunities to practice testing themselves on their knowledge of anatomical structures. In addition to being tailored to the UVA medical students' MSI anatomy curriculum, these updated lab manuals provide students with many options in how they wish to study the material.

Together, these changes resulted in a new, interactive lab manual clearly stating the dissection instructions side by side with photographs of the pertinent anatomy. This newly developed lab manual will be used for the course this coming year. Our goal is to obtain student feedback from the Class of 2022 to determine what aspects of the new lab manual students like, as well as additional ways to continue improving it for the following years. If the changes made here improve student learning, we would like to implement them for additional courses, such as the Gastrointestinal System, and Mind, Brain and Behavior Labs.

Poster #41

Imputation of PaO₂/FiO₂ from SpO₂ in Non-Mechanically Ventilated Patients

Chelsea Lau, M4 and Shirang Gadrey, MD

Background: The PaO₂/FiO₂ (PF) ratio is an important metric evaluating pulmonary oxygenation function. Yet, when it comes to risk predictive analytic techniques deployed in non-ICU settings, its utility is quite poor. This is largely attributable to the fact that calculating the PF

ratio requires an arterial blood gas (ABG) sampling, an expensive and invasive test used sparingly outside the ICU. Several formulae exist that allow imputation of PF ratio from oxygen saturation (SpO_2), measured by widely available, non-invasive pulse oximetry. However, imputed PF ratios often show proportional and fixed biases relative to measured PF ratios, particularly when SpO_2 is $\geq 96\%$. Additionally, these formulae have been more rigorously studied in intubated ICU patients rather than in non-intubated general medicine ward patients.

Methods: ABG values and supporting data from non-mechanically ventilated patients hospitalized at a single tertiary care center hospital from 2013-2017 were obtained via SQL queries to the EHR data warehouse. Only those ABGs were retained which had a documented $\text{SpO}_2 \leq 5$ minutes prior to ABG draw time. Accuracy of query generated data was verified via randomized manual review. Existing non-linear, linear, and log-linear equations were used to impute estimated PF ratios from SpO_2 and compared to actual values as calculated from ABG measurements. The non-linear equation was modified to improve its imputation performance in patients with high SpO_2 values ($\geq 96\%$), and its output was compared to that of the original equation. We then assessed the output of all equations as ordinal values binned according to SOFA pulmonary score boundaries.

Results: A total of 1323 ABG measurements were obtained via our data query, 351 of which were obtained within 5 minutes of a corresponding SpO_2 . Proportional and fixed biases were assessed using major axis regression (Model II linear regression) analysis of the imputed PF ratios against measured PF ratios. More bias was found in PF ratios imputed using the linear and log-linear equations than the non-linear equation at all saturation levels. Additionally, while the non-linear equation results in unbiased imputation at saturations $< 96\%$, it shows significant bias at higher saturations. Our modification to the non-linear equation resulted in resolution of this bias at higher saturations. Finally, when we compared pulmonary SOFA scores using imputed PF ratios, we found a high degree of agreement when the non-linear equation was used with our modification for higher saturations.

Conclusions: In non-mechanically ventilated patients with high ($\geq 96\%$) pulse oximetry values, our modified non-linear equation outperformed existing equations with higher accuracy, decreased proportional bias, and improved performance in calculating the pulmonary component of the SOFA score. These results, if validated in prospective studies and replicated in various centers could lead to enhanced clinical utility of imputed PF ratios in predictive analytics in non-ICU settings.