



University of Colorado  
Anschutz Medical Campus

ANNUAL STUDENT MSA CAPSTONE PRESENTATIONS

February 27, 2020

ANSCHUTZ MEDICAL CAMPUS  
HEALTH SCIENCES LIBRARY

**Poster Sessions**

Session A: 2:00 pm – 3:00 pm

Session B: 3:00 pm – 4:00 pm

Session C: 4:00 pm – 5:00 pm

The MSA Directors would like to acknowledge, with gratitude, the support for medical student research provided by:

**The University of Colorado**  
**School of Medicine Dean's Office**  
*And*  
**Undergraduate Medical Education Office**

**Poster Session Judges**

The organizing committee wishes to acknowledge their appreciation to the following serving as judges for the MSA Capstone Presentations. Without their generous contribution of time and talent the forum would not be possible. Thank you!

<i>Douglas Adams</i>	<i>Shaodong Dai</i>	<i>Wladimir Labeikovskiy</i>	<i>David Orlicky</i>
<i>Jill Alldredge</i>	<i>Amira del Pino-Jones</i>	<i>Courtney Lynn</i>	<i>Allan Prochazka</i>
<i>Marsha Anderson</i>	<i>Caleb Doll</i>	<i>Helen Macfarlane</i>	<i>Erin Rubin</i>
<i>Laura Anthony</i>	<i>Marisa Echaniz</i>	<i>Shideh Majidi</i>	<i>Deb Seymour</i>
<i>Stephen Berman</i>	<i>Marisa Friederich</i>	<i>James Maloney</i>	<i>Ingrid Summers</i>
<i>Aimee Bernard</i>	<i>Daniel Goldberg</i>	<i>Sean Marshall</i>	<i>Minghua Tang</i>
<i>Amber Berning</i>	<i>Adam Green</i>	<i>Leana May</i>	<i>John Tentler</i>
<i>Manisha Bhide</i>	<i>Patrick Henn</i>	<i>Bruce McCollister</i>	<i>Kalie Tommerdahl</i>
<i>Benjamin Bitler</i>	<i>Patricia Heyn</i>	<i>Sandy Martin</i>	<i>Suhong Tong</i>
<i>Andy Bradford</i>	<i>Jacob Holzman</i>	<i>Niklaus Mueller</i>	<i>Jeniann Yi</i>
<i>Sarah Brewer</i>	<i>Sharon Hunter</i>	<i>Kristen Nadeau</i>	<i>Zhiying You</i>
<i>Joseph Brzezinski</i>	<i>Tracy P Johnson</i>	<i>Rooban Nahomi</i>	<i>Phillip Zeitler</i>
<i>Christine Chan</i>	<i>Jill Kaar</i>	<i>Nivedita Naresh</i>	<i>Ali Zirakzadeh</i>
<i>Michelle Clementi</i>	<i>Francisco La Rosa</i>	<i>Anna Neumeier</i>	<i>Shanta Zimmer</i>
<i>Tyler Coyle</i>			

Primary Presenter: Davis Aasen

Project Title: *Systematic Review of Preoperative Risk Discussion in Practice*

Primary Mentor: Robert Meguid, Department of Surgery

Thematic Area: Clinical Science

Abstract:

**Background**

Informed consent is an ethical imperative of surgical practice. This requires effective communication of procedural risks to patients and is learned during residency. No systematic review has yet examined current risk disclosure. This systematic review aims to use existing published information to assess preoperative provision of risk information by surgeons.

**Methods**

Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) as a guide, a standardized search in Ovid MEDLINE, Embase, CINAHL, and PubMed was performed. Three reviewers performed the study screening, with two-reviewer consensus required at each stage. Studies containing objective information concerning preoperative risk provision in adult surgical patients were selected for inclusion. Studies exclusively addressing interventions for pediatric patients or trauma were excluded, as were studies addressing risks of anesthesia.

**Results**

The initial search returned 12,988 papers after deduplication, 33 of which met inclusion criteria. These studies primarily evaluated consent through surveys of providers, record reviews and consent recordings. The most ubiquitous finding of all study types was high levels of intra-surgeon variation in what risk information is provided to patients preoperatively. Studies recording consents found the lowest rates of risk disclosure. Studies using multiple forms of investigation corroborated this, finding disparity between verbally provided information versus chart documentation.

**Conclusions**

The wide variance in what information is provided to patients preoperatively inhibits the realization of the ethical and practical components of informed consent. The findings of this review indicate that significant opportunities exist for practice improvement. Future development of surgical communication tools and techniques should emphasize standardizing what risks are shared with patients.

Primary Presenter: Natasha Aguirre

Project Title: *Pre- and post-operative counseling for women on hormonal contraceptives receiving sugammadex at an academic hospital*

Primary Mentor: Aaron Lazowitz, Division of Family Planning, Department of Obstetrics and Gynecology, University of Colorado Anschutz Medical Campus.

Thematic Area: Clinical Science

Abstract:

Sugammadex is a steroid binder and can potentially bind the estrogens and progestins contained within hormonal contraception. Therefore, the FDA label for sugammadex contains a drug-drug interaction warning between this medication and hormonal contraception, advising that women taking hormonal contraception use a backup contraceptive method or abstinence for seven days after exposure to sugammadex. However, given concerns that this warning may not be appropriately provided to at-risk patients, we conducted a retrospective chart review to identify women administered sugammadex while using hormonal contraception to identify documented counseling on this drug-drug interaction prior to implementation of a formalized counseling process. We reviewed 1000 randomly selected charts from the University of Colorado Hospital between January 2016 and December 2017. We identified 134 women using hormonal contraception at the time of sugammadex exposure; only one patient (0.7%, 95% CI 0.0, 4.1) had documented counseling. One patient had an unintended pregnancy within the same cycle as her exposure to sugammadex. Improved counseling processes are needed to avoid unnecessary risk for unintended pregnancies.

Primary Presenter: Abdel Albakri

Project Title: *The Impact of Time Horizon on Classification Accuracy: Application of Machine Learning to Prediction of Incident Coronary Heart Disease*

Primary Mentor: Michael Rosenberg, Cardiology, Personalized Medicine

Thematic Area: Clinical Science

Abstract:

#### Background

Many machine-learning (ML) approaches are limited to classification of outcomes, rather than longitudinal prediction. One strategy to use ML in clinical risk prediction is to classify outcomes over a given time horizon. However, it is not well-known how to identify the optimal time horizon for risk prediction.

#### Objective

An optimal time horizon for classification of incident coronary heart disease (CHD) can be identified iteratively using ML approaches looped over outcomes with increasing time horizons.

#### Methods

We utilized anonymized data from a single clinic visit of 4708 African-American participants of the Jackson Heart Study with no prior history of CHD. We examined 85 covariates collected from this baseline exam including demographic and biologic data, medical history, medications, serum biomarkers, cardiac imaging and electrocardiographic data. Using an endpoint of incident CHD, we applied multiple machine learning methods across annual time horizons from 1 through 15 years of follow up. Models were compared on a 20% held-out testing set.

#### Results

There were 4708 participants included in the analysis with an average age of 54.7 years, 64% female, and a median follow-up time of 11.8 years (+/- 1.8 years) during which there were 251 CHD events. The ML models were generally most predictive over moderate time horizons with the exception of the L1 (Lasso) logistic regression, which was most predictive at one year with an area-under-ROC of 0.83 for classification of incident CHD.

#### Conclusions

In a population free of coronary heart disease, machine learning techniques can be utilized to accurately predict development of coronary heart disease at varying time horizons with moderate time horizons being the most predictive. Incorporation of additional modeling approaches, as well as validation across additional populations, is needed to confirm a role for this approach in risk prediction.

Primary Presenter: Erin Aldag

Project Title: *Group B Streptococci colonization in pregnant women in rural Guatemala: Prevalence and neonatal outcomes*

Primary Mentor: Leana May, Center for Global Health, Pediatric Emergency Medicine

Secondary Mentor(s): Edwin Asturias

Thematic Area: Global Health

Abstract:

Background

Group B Streptococcus (GBS) colonization in pregnant women is strongly associated with neonatal early onset sepsis. Although GBS intrapartum antibiotic prophylaxis can significantly reduce adverse neonatal outcomes, it is not standard of care in Guatemala. A lack of robust epidemiologic data may limit current practice. Recently, we identified a 17.3% prevalence rate of GBS colonization among pregnant women living in an urban area of Guatemala. However, little is known about GBS colonization in rural areas of Guatemala.

Objective

To identify the prevalence of GBS colonization among pregnant women in rural Guatemala and to assess infection-related neonatal outcomes.

Design/Methods

This is a prospective cohort study conducted through a community health program in the rural southwest Trifinio region of Guatemala from May 2018 to August 2019. Consented women  $\geq 28$  weeks gestation had a single rectal-vaginal swab collected by trained nurses, which was then plated on a chromagar culture and incubated for 48 hours. Bacterial growth suspected as GBS was tested with latex agglutination. Positive chromagar and latex agglutination results were considered confirmed GBS colonization. Per ethical considerations, CDC intrapartum treatment recommendations for GBS were provided to women with suspected or confirmed GBS to provide to their clinicians at delivery. Neonatal outcomes including illnesses, hospitalizations, and medications were elicited by parent report during 3 in-home visits by trained nurses during the first 30 days of life and medical record review.

Results

153/154 (99.4%) women enrolled and had rectal-vaginal samples collected. 63 (41.2%) women had suspected GBS bacterial growth on chromagar. Of these, 10 were positive on latex agglutination giving an overall GBS colonization rate of 6.5% (95%CI: 3.2-11.7%). 145 infants were enrolled. 7 (4.8%) infants had infection related hospitalizations or death requiring antibiotics within 30 days of birth, of whom 1 had a mother with suspected but not confirmed GBS.

Conclusion(s)

GBS colonization among pregnant women in rural Guatemala may be lower than rates identified in urban Guatemala. Infants experienced high infection-related morbidity during the first 30-days of life, but this was not associated with maternal GBS colonization. This lack of association may be due to

provision of treatment recommendations for GBS colonization, inadequate detection of GBS, or non-GBS related infections. Findings may inform prioritization of GBS prophylaxis programs in Guatemala.

Primary Presenter: Devon Anderson

Project Title: *Relationship Between Antibiotic Treatment for Urinary Tract Infection and Hospital Outcomes in Dementia Patients Admitted with Behavioral Disturbance*

Primary Mentor: Amira del Pino-Jones, Hospitalist - University of Colorado Hospital

Secondary Mentor(s): Kanwal Awan MD - Division of Geriatric Medicine and Gerontology Johns Hopkins University School of Medicine

Christopher Marano MD - Division of Geriatric Psychiatry and Neuropsychiatry Johns Hopkins University School of Medicine

Thematic Area: Clinical Science

Abstract:

#### Background

The behavioral and psychological symptoms of dementia (BPSD) have multiple causes including an acute medical condition. Therefore, patients with BPSD often undergo extensive medical work-up. Although screening for urinary tract infection (UTI) in the absence of clinical symptoms is not recommended, providers often obtain urinalysis (UA) and culture in these patients. As a result, many patients receive antibiotics for a presumed UTI, hoping to treat the BPSD. Our objective is to explore the relationship between UTI and its treatment on outcomes in dementia patients hospitalized for BPSD including length of stay, antipsychotic prescription on discharge, number of psychotropic medications on discharge, and functional mobility and transfers.

#### Methods

We reviewed charts of 160 dementia patients admitted to a chronic medical psychiatry unit for BPSD from May 2016 to March 2017. We defined positive UA as pyuria plus leukocyte esterase and/or nitrates. We defined positive culture as >100,000 colony forming units. We assessed functional mobility and transfer using the Functional Independence Measure (FIM). We measured differences between groups using ANOVA and used a p value of <0.05 to indicate statistical significance.

#### Results

43% of the patients had a positive UA (N=68). Of patients with a positive UA, 21% (N=14) had a positive culture and 32% (N=22) received antibiotics. We found no statistically significant difference in length of stay, antipsychotic prescription on discharge, number of psychotropic medications on discharge, FIM score between patients with a negative UA, patients with a positive UA not treated with antibiotics, and patients with a positive UA treated with antibiotics.

#### Conclusions

Antibiotic treatment for UTI did not affect outcomes in patients hospitalized for BPSD. Clinicians should exercise caution when prescribing antibiotics in this frail elderly population.



Primary Presenter: Elliott Antman

Project Title: *A Rare Case of Hypocalcemia Complicating Pregnancy*

Primary Mentor: Michel Chonchol, Renal Diseases and Hypertension

Secondary Mentor(s): John Carson, MD

Thematic Area: Clinical Science

Abstract:

Autosomal dominant hypocalcemia (ADH) is a rare and possibly underdiagnosed cause of hypocalcemia. We describe the case of a 31 year old female who initially presented with symptomatic hypocalcemia at the age of 22. She was presumed to have autoimmune hypoparathyroidism. She was treated with vitamin D and calcium supplementation until developing nephrocalcinosis at the age of 25. A thiazide diuretic was added along with recombinant PTH for persistent hyperphosphatemia. She subsequently developed symptomatic hypomagnesemia with profound hypermagnesuria which persisted after discontinuing the thiazide. Her first pregnancy at 29 years old was complicated by hypomagnesemia and intrauterine demise in the third trimester. The patient was referred to nephrology at this point in her course. During her second pregnancy at age 31 the patient underwent genetic testing for ADH in the setting of persistent hypomagnesemia, hypocalcemia, and hypercalciuria with nephrocalcinosis. The pregnancy was complicated by polyhydramnios at 35 weeks gestation. Labor was induced and she delivered a baby girl. At two days of life the infant became bradycardic and had a generalized seizure. Serum calcium of the infant revealed hypocalcemia. At four days post-partum the patient's genetic testing revealed ADH.

Autosomal dominant hypocalcemia offers a worthwhile examination of calcium homeostasis, particularly PTH independent regulation of calcium. The calcium sensing receptor, described in previous studies, is found in high concentrations at the parathyroid gland and kidney and is a key component in PTH-independent calcium regulation. An examination of ADH also highlights various diagnostic challenges with rare and possibly under diagnosed diseases. Upon diagnosis, ADH presents multiple treatment challenges, including persistent hypocalcemia, nephrocalcinosis, and hypomagnesemia. In this case report, we will describe the underlying physiology of calcium regulation, the pathophysiology of ADH, and diagnostic and treatment challenges of this disease.

Primary Presenter: Nicholas Arlas

Project Title: *The Youth Community Health Awareness Partnership: Community-based participatory research initiative to assess the scope of alcohol use within the community of refugees from Burma in the greater Denver area*

Primary Mentor: Janet Meredith, Family Medicine

Secondary Mentor(s): Dr. Bethany Kwan

Thematic Area: Global Health

Abstract:

#### BACKGROUND

For more than fifty years, minorities in Burma have faced severe persecution and violence that has forced them to flee their homeland. In the past ten years there has been an influx in the number of refugees resettled in Denver. Refugees often struggle to navigate the complexities of the American health care system and adapt to life in a foreign culture. The development of novel programs and partnerships to assist refugees in their pursuit of health and integration is essential to build stronger, cohesive communities.

#### METHODS

Beginning in 2014, a multi-phase community based participatory research (CBPR) project was developed in collaboration with the refugee community from Burma residing in the greater Denver area. The first phase of the project involved establishing a partnership with the community. A group of motivated teenagers and young adults from this community collaborated to form our Youth Advisory Board (YAB). We met regularly with the YAB to discuss and prioritize health issues. They identified alcohol use and misuse as the paramount health concern within their community. Formative information was elicited from community leaders, local refugee organizations, healthcare providers, and informal surveys to guide future research tools. With this identified issue, the project moved into phase two of data collection. Phase two involved conducting formal one-on-one, semi-structured, audio-recorded interviews with community members. Participants were recruited voluntarily at health information nights held by the student researchers at their local apartment complex. The interviews were conducted by one medical student researcher with one translator present and were transcribed afterward. Phase three, the current phase of the project, includes data analysis and presenting our findings to the community. The interview data was analyzed using Immersion Crystallization methodology. This data will be leveraged to create, implement, and evaluate a culturally competent intervention to effectively address risky alcohol use in this affected community.

#### RESULTS

Initial results from the nineteen meetings with the YAB, fourteen meetings with local organizations, nineteen formative community surveys, and three key informant interviews pointed to the vulnerability of the refugee population, the scarcity of culturally appropriate resources for alcohol abuse, and the urgency of addressing problematic alcohol use. The analysis of the ten audio-recorded surveys showed the emergence of several themes related to the use of alcohol within this community. Themes identified through qualitative analysis include negative consequences of alcohol use, specifically negative impacts

on familial relationships, employment, and financial resources, and a perceived personal responsibility for managing one 's own alcohol consumption.

#### CONCLUSIONS

This project corroborates current literature regarding the scope and breadth of hazardous alcohol use within the community of refugees from Burma. Our data has expanded our understanding of the values of community members including the influence of religion and family on behaviors, and the negative impact on employment as the most impactful negative consequence. These findings need to be shared with the community to move forward in mapping the most effective and appropriate interventions.

Primary Presenter: Alvaro Assuncao

Project Title: *Characterization and Influence of Scapula Fracture Among Patients Who Undergo Surgical Stabilization of Rib Fractures*

Primary Mentor: Fredric Pieracci, Surgery

Thematic Area: Clinical Science

Abstract:

#### Introduction

Current algorithms involving surgical stabilization of rib fractures (SSRF) do not consider specific fracture locations. The combination of displaced, sub-scapular rib fractures and a scapula fracture creates challenges for both rib exposure and fixation, which may in turn adversely affect both hardware longevity and shoulder function. We hypothesized that a scapula fracture is associated with both acute and long term morbidity among a sample of patients with sub-scapular rib fractures who underwent SSRF.

#### Methods

Retrospective review of prospectively-maintained SSRF databases from two high volume (at least 30 SSRF cases per year), level I trauma centers. The sample was comprised of patients with at least one bi-cortical, sub-scapular rib fracture, defined as ribs 2-7 within 2 cm of the edge of the scapula on admission CT chest. Patients were then grouped by the presence of a scapula fracture. Demographics, injury severity, scapula fracture morphology, acute outcomes, and the need for subsequent hardware removal were abstracted.

#### Results

111 patients with a median of 4 (range 1-11) sub scapular fractures underwent SSRF and were analyzed. 68 (60.3%) patients had at least one sub- scapular plate placed. 31 (27.9%) patients had a scapula fracture; 2 were bilateral, 2 involved the glenoid (the remainder involved only the scapula body), and 1 underwent fixation (4 days following SSRF). There were no differences identified in patient demographics, injury severity, or rib fracture severity as a function of a scapula fracture (Table). The overall incidence of both acute re-operation (n=2, 1.8%) and long-term hardware removal (n=4, 3.6%) following SSRF was low. However, patients with a scapula fracture were significantly more likely to require hardware removal as compared to patients without a scapula fracture (9.7% vs. 1.3%, respectively, p=0.03). Furthermore, each case of hardware removal from a patient with a scapula fracture entailed removal of sub-scapular plates specifically due to a painful grinding sensation with shoulder movement. The singular case of hardware removal in a patient without a scapula fracture was due to infection of antero-lateral plates.

#### Conclusion

Ipsilateral scapula fractures were present in approximately one third of patients with displaced, sub-scapular rib fractures who underwent SSRF. The vast majority of scapula fractures involved the body (directly anterior to the rib fractures) and were not repaired. Patients with a scapular fracture were significantly more likely to require rib hardware removal, specifically in the sub scapular location. Alternative techniques to SSRF in this clinical scenario, including fixation to the inner rib cortex and simultaneous scapular body fracture repair, should be studied.

Primary Presenter: Patrick Autruong

Project Title: *Characterization of Post-Operative Sedation Using an EEG-based Monitor in the PACU*

Primary Mentor: Ana Fernandez-Bustamante, Anesthesiology

Thematic Area: Clinical Science

Abstract:

Introduction

The ability to accurately monitor levels of consciousness and sedation has become a priority in the field of anesthesia. As a result, electroencephalogram (EEG) based monitors have gained popularity. These monitors have been used intra-operatively and in intensive care unit (ICU) settings, and have been shown to have advantages versus conventional subjective sedation scales. An EEG-based monitor has not been studied in the post-anesthesia care unit (PACU), where sedation is an important complication to monitor for. The purpose of this study was to characterize the use of one of these monitors, the SedLine, in a post-operative setting.

Methods

The authors conducted a prospective, observational study of patients receiving monitoring with the SedLine device during and after surgery. PSi values were recorded every 15 minutes for the duration of the patient's PACU stay, up to 2 hours. Moline-Roberts Sedation Scale assessments, made by clinical staff per normal protocol, were compared to PSi with linear regression was performed to determine any correlation.

Results

A total of 10 patients were included for analysis with mean age of 47.2. Mean PSi was 94.1 at arrival to PACU. PSi decreased during the first 60 minutes to a minimum of 88.7, then improved to a mean of 91.3 at 2 hours. A total of 31 observations of PSi below 90 occurred. Linear regression of 57 assessments of sedation showed a correlation coefficient of 0.05 ( $p=0.11$ ), indicating no correlation.

Discussion

PSi in the PACU for this series of patients dropped to a level that has been shown to be associated with mild to moderate sedation in prior studies. On subjective assessment, however, no patients were observed to be overly sedated, and no adverse events occurred. While PSi may have utility as a sedation monitor, and be superior to subjective scales in other settings, further investigation into its use in the PACU is necessary.

Primary Presenter: Adam Avant

Project Title: *Lack of Prenatal Vitamins and Anti-malarial Medications during Pregnancy is Associated with Maternal Complications in Rural Uganda*

Primary Mentor: Madiha Abdel-Maksoud, Global Health

Thematic Area: Global Health

Abstract:

#### Background

Maternal morbidity and mortality remains a major issue in Uganda. This study looks at Mpigi Health Center IV (MHCIV), a community based referral center serving a large catchment area.

#### Objectives

To use a survey to study socioeconomic and psychosocial factors and their correlation with maternal outcomes in rural Uganda at MHCIV.

#### Methods

A survey was developed and administered a survey to 147 women who delivered at the health center from June 12 to July 12 2017. It was administered in-person via interpreters when needed, and included 33 questions (maternal sociodemographic factors, prenatal conditions and care, mode of delivery and maternal complications). The outcome variable, maternal complications, was a composite variable including: miscarriage, fetal death, pre-eclampsia, prolonged labor, uterine rupture, post-partum hemorrhage and puerperal sepsis. Descriptive statistics were used to summarize the data, and multivariable logistic regression was used to examine the independent associations between the above-mentioned factors and maternal complications.

#### Findings

The average age of participants was 26.4 years. 60.5% of participants reported taking iron, 62% reported taking folic acid, and 56.5% reported taking sulfadoxine-pyramethamine for malarial infection or prevention of infection during pregnancy. Analysis revealed that pregnant women who did not take these three medicines were 5.472 times more likely to have maternal complications than those who took them.

#### Conclusions

In this study, the absence of prenatal medications during pregnancy was associated with increased risk of maternal complications. These medicines are prescribed by the prenatal clinic at MHCIV, and the intake of these could be an indicator of compliance with prenatal care in general. Therefore, increasing awareness about the importance of prenatal care, including the intake of supplements and antimalarials, in addition to ensuring the availability of these compounds is critical to reduce the burden of maternal complications in Mpigi and other high malaria burden regions.

Primary Presenter: Erika Baird

Project Title: *Clinical implications of ALDH1A1 and ALDH1A3 mRNA expression in melanoma subtypes*

Primary Mentor: Mayumi Fujita, Department of Dermatology

Thematic Area: Basic Biomedical Science

Abstract:

Aldehyde dehydrogenase (ALDH) activity is not only a valuable marker for cancer cells with stem-like features, but also plays a vital role in drug resistance and disease progression in many tumors including melanoma. However, the precise role of ALDH activity in patient prognosis remains unclear. In this study, using the Cancer Genome Atlas (TCGA) RNA-sequencing expression data, we analyzed gene expression of ALDH isozymes in melanoma tumors to define the expression patterns and the prognostic and predictive values of these enzymes. We found that ALDH1A1 and ALDH1A3 had both higher and broader expression ranges in melanoma patients, and that ALDH1A3 expression correlated with better overall survival in metastatic melanoma. Further, stratification of the TCGA cohorts by the mutational subtypes of melanoma specifically revealed that expression of ALDH1A3 correlated with better prognosis in metastatic BRAF-mutant melanoma while expression of ALDH1A1 correlated with better prognosis in BRAF wild-type melanoma. Gene set enrichment analysis (GSEA) of these cohorts identified upregulation in oxidative phosphorylation, adipogenesis, and fatty acid metabolism signaling in ALDH1A<sub>lo</sub> patients, suggesting BRAF/MEK inhibitor resistance in that subset of patients. On the other hand, GSEA of ALDH1A<sub>3hi</sub> cohorts revealed upregulation in glycolysis, hypoxia and angiogenesis, suggesting BRAF/MEK inhibitor sensitivity in that subset of patients. Gene expression analysis using pre-treatment tumor samples supports high ALDH1A3 expression before BRAF/MEK inhibitor treatment as predictive of better treatment response in BRAF-mutant melanoma patients. Our study provides evidence that high ALDH1A3 mRNA expression is not only a prognostic marker but also a predictive marker for BRAF/MEK inhibitor treatment response in BRAF-mutant metastatic melanoma patients.

Primary Presenter: Vance Barksdale

Project Title: *The Dark Effusion*

Primary Mentor: Mark Duncan, Internal Medicine

Thematic Area: Clinical Science

Abstract:

Case information

A 50-year-old female with history of anorexia/bulimia, alcohol use disorder and chronic pancreatitis presented to the emergency department overnight with atypical chest pain. Acute coronary syndrome work up was negative, lipase was 480 U/L, and abdominal ultrasound was unremarkable. She was given a diagnosis of acute pancreatitis and failure to thrive, and admitted for IV fluids, physical therapy and rehabilitation placement. During morning rounds, the patient complained of persistent left-sided pleuritic chest pain and a chest x-ray revealed a large left pleural effusion. Diagnostic thoracentesis showed a black aspirate that was exudative with an amylase level of 10,915 U/L. She underwent ERCP, with a final diagnosis of pancreaticopleural fistula.

Discussion

A black pleural effusion is a rare and striking feature that quickly narrows the differential diagnosis. Some important causes of black pleural effusions are malignancy (including metastatic melanoma), fungal infections, and pancreaticopleural fistulae. A pancreaticopleural fistula is a rare complication of pancreatitis and presents as a large, often left-sided pleural effusion with amylase-rich pleural fluid. During handoff, the patient's one-liner highlighted psychiatric illness and substance misuse, which promoted misleading framing and visceral bias. When framed this way, the team anchored on acute pancreatitis despite the fact that she had no characteristic symptoms or radiologic evidence, and thus did not meet diagnostic criteria. Providers manifest visceral bias as countertransference when they perceive a patient as difficult, and is often related to mental illness or substance use. The result was suboptimal care including dismissal of complaints. When the team reframed the presentation around her chief complaint, they discerned a black pleural effusion and brought to light her true diagnosis of pancreaticopleural effusion.



Primary Presenter: Abigail Barnes

Project Title: *Manufacturer and User Facility Device Experience Review of Endometrial Ablation Devices*

Primary Mentor: Edward Jones, Surgery

Secondary Mentor(s): Jill Liss, OBGYN

Thematic Area: Clinical Science

Abstract:

Background

The Manufacturer and User Facility Device Experience (MAUDE) database was created in 1991 as a response to the growing number of device reports and the need for an organized presentation of the data to the public. Maude is used by the FDA to detect potential safety issues and to monitor device performance. It is also used by many researchers as a tool in analyzing patient injury or death related to various medical devices used in many fields of medicine including gynecology. Endometrial Ablation (EA) is indicated in the treatment of heavy menstrual bleeding in premenopausal patients who no longer desire fertility. A variety of devices are used for this procedure and reports of injury or death are available in the MAUDE Database.

Study Design

The FDA Manufacturer and User Facility Device Experience (MAUDE) database was searched for adverse events categorized as injury or death related to the use of endometrial ablation devices. Reports generated between May 1, 2009 and May 31, 2019 were included. Results were classified based on year, type of device, mechanism of injury, severity of injury and cause of death.

Results

A total of 1,220 reports were screened with 1,219 being injuries and 10 deaths. 251 Reports were excluded for insufficient information, duplicate, pain, or device malfunction without injury leaving 978 reports included. Our study suggests that specific devices have injury patterns such as uterine perforation, hysterectomy and bowel resection/ repair with bipolar radiofrequency ablation and thermal injuries with thermal balloon and hot saline ablation devices.

Conclusion

The advances in technology for endometrial ablation devices bring both opportunities for patients to gain relief from abnormal uterine bleeding but also expose patients to various risks of injury. These injury types are challenging to track which is why databases like MAUDE are beneficial. This information is important for providers to accurately counsel patients on the risks of undergoing an endometrial ablation procedure.

Primary Presenter: Oliver Bawmann

Project Title: *The Relationship Between Experiencing Gratitude and Psychological Distress in University of Colorado Medical Students*

Primary Mentor: Katherine Morrison, Internal Medicine - Palliative Care

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Medical students are at increased risk of burnout compared to age matched peers. Burnout is associated with significant negative consequences for medical students (depression, suicidal ideation, alcohol abuse) as well as for patients. Research has shown that gratitude interventions can lessen stress and depressive symptoms in populations other than health care providers and trainees. As such, the authors hypothesized that there would be an inverse correlation between experiencing gratitude and forms of psychological distress such as burnout and depression in medical students.

Second and third year medical students were administered the Medical Student Well-Being Index (MSWBI) and the Gratitude Questionnaire (GQ-6), which assesses propensity to experience gratitude. The results of these instruments were analyzed to assess for correlation between gratitude and distress in surveyed students.

Data demonstrated a statistically significant inverse correlation between burnout and gratitude, as well as depression and gratitude in both classes of students ( $p < 0.05$ ). There was also a statistically significant inverse correlation between gratitude and feeling overwhelmed in second year students ( $p = 0.026$ ).

Results of this study demonstrate that having more gratitude is associated with experiencing less burnout, depression, and feeling overwhelmed. Given that gratitude interventions are inexpensive and require minimal time, they may represent a viable solution to improving well-being in medical students and may be extrapolated to physicians and health care providers to contribute to a culture of wellness. Future studies should explore the effects of gratitude interventions in increasing gratitude and alleviating distress.

Primary Presenter: Theodore Black

Project Title: *Can the diagnostic accuracy of pediatric patients with suspected appendicitis be improved? A comparative analysis of misdiagnosed cases.*

Primary Mentor: Joe Grubenhoff, Emergency Medicine

Secondary Mentor(s): Stephanie Staab

Thematic Area: Clinical Science

Abstract:

**Background**

Appendicitis is the most common surgical emergency in children but remains a challenging diagnosis. Cases of negative appendectomy (NA) and delayed diagnosis appendicitis (DDA) are reported to occur 4-5% at the time of presentation. We sought to compare patients with pathology-confirmed appendicitis (PCA) to those with NA and DDA to improve our diagnostic accuracy. Objective: To identify distinguishing features at the time of presentation to improve diagnosis of children who go on to appendectomy.

**Methods**

Secondary analysis of data collected during a QI project to ensure accurate diagnosis of appendicitis at a single academic tertiary care children 's hospital system. Pathology reports were reviewed for all appendectomies in 2015-2016 (n=1,189). Negative appendectomies were defined as those with no pathologic change or findings consistent with a different diagnosis. Cases of DDA were defined as patients who underwent appendectomy who had an ED visit for a related complaint within the preceding seven days. Interval and incidental appendectomies were excluded. The electronic medical records of all cases of NA, DDA, and a random sample (n=150) of PCA cases were reviewed. Demographic and clinical variables were extracted. Data were analyzed using standard comparative statistics.

**Results**

In 2015 and 2016, 42 cases of NA (3.5%) and 31 cases of DDA (2.6%) were identified. Cases with PCA and those with a NA were similar in terms of historical features, exam findings, and diagnostic workup. Cases with PCA were more likely to have a WBC count > 10x10<sup>3</sup>/uL (p = 0.01) and a left-shift (p < 0.001). They were more likely to have an ultrasound that was interpreted as high probability for appendicitis. There were numerous differences in historical features, exam findings, diagnostic tests, and therapeutic choices between children with PCA and cases of DDA.

**Conclusions**

Children with PCA and those with NA present similarly and undergo a comparable evaluation. This is in contrast to children with acute appendicitis in whom diagnosis is delayed. Our data show that these children present differently and the diagnosis of appendicitis is therefore unlikely to have been considered from the outset.

Primary Presenter: Jason Bunn

Project Title: *Geography and Population Characteristics Associated with Prevalence of Abusive Head Trauma in the US*

Primary Mentor: Stig Somme, Surgery - Pediatric Surgery

Thematic Area: Clinical Science

Abstract:

The collective moral failure of pediatric non-accidental trauma (NAT), and specifically abusive head trauma (AHT), is difficult to estimate and bears devastating health consequences and costs. Unfortunately, regional differences within the US remain largely unknown. Knowledge of geographic distinctions might lead to highly focused prevention efforts and an overall reduction in harm. We hypothesized that regional differences in abusive head trauma (AHT) prevalence exist within the United States. The Pediatric Health Information System (PHIS) was queried for head trauma and further subdivided into accidental head trauma, definite AHT and probable AHT. Of years 2010-2017, 160,596 patients were identified with head trauma. Of these, 20,811 (13.0%) met the criteria for either definite or probable head trauma. Reporting PHIS hospitals were cross-matched with American Community Survey (ACS) 1-year estimates to obtain state unemployment rate. Of definite AHT patients, 58% presented to PHIS hospitals in states with an unemployment rate below the national median. Abusive head trauma (as a percentage of total head trauma) increased from 2010 (11%) to 2017 (20%). Metropolitan, micropolitan and rural small town percentages of AHT (percentages of total head trauma cases) were 12%, 18% and 16%, respectively. Median rate of AHT was .13. Descriptively, prevalence of AHT is not associated with particular US regions.

COI: The authors have no conflicts of interest to disclose.

Primary Presenter: Samuel Carpentier

Project Title: *The signaling adaptor BCAP inhibits NLRP3 and NLRC4 inflammasome activation in macrophages through interactions with Flightless-1*

Primary Mentor: Thomas Morrison, Immunology and Microbiology

Thematic Area: Basic Biomedical Science

Abstract:

B cell adaptor for phosphoinositide 3-kinase (PI3K) (BCAP) is a signaling adaptor that activates the PI3K pathway downstream of B cell receptor signaling in B cells and Toll-like receptor (TLR) signaling in macrophages. BCAP binds to the regulatory p85 subunit of class I PI3K and is a large, multidomain protein. We used proteomic analysis to identify other BCAP-interacting proteins in macrophages and found that BCAP specifically associated with the caspase-1 pseudosubstrate inhibitor Flightless-1 and its binding partner leucine-rich repeat flightless-interacting protein 2. Because these proteins inhibit the NLRP3 inflammasome, we investigated the role of BCAP in inflammasome function. Independent of its effects on TLR priming, BCAP inhibited NLRP3- and NLRC4-induced caspase-1 activation, cell death, and IL-1 $\beta$  release from macrophages. Accordingly, caspase-1 -dependent clearance of a *Yersinia pseudotuberculosis* mutant was enhanced in BCAP-deficient mice. Mechanistically, BCAP delayed the recruitment and activation of pro -caspase-1 within the NLRP3/ASC preinflammasome through its association with Flightless-1. Thus, BCAP is a multifunctional signaling adaptor that inhibits key pathogen-sensing pathways in macrophages.

Primary Presenter: Rae Carroll

Project Title: *Bias, Narrative and Storytelling: A Voice For Our Underserved LGBTQ Patients*

Primary Mentor: Therese Jones, Bioethics and Humanities

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Introduction

It is a well-known fact that patients within the LGBTQ community face many barriers and much discrimination in seeking healthcare, and that as a result, utilization of health resources is low for this group, leading to many serious, untreated health concerns. While a lot of qualitative research has been done in this area, it is the goal of this project to consolidate the shared concerns, fears, poor experiences, good experiences, power imbalances, moments of quiet dysphoria, identity challenges, and isolation experienced by this population into a form that constitutes advocacy instead of simply reportage. By interviewing patients about their experiences, I will build a bank of experiences to draw from in order to construct a narrative that gives these patients a voice with the power inherently contained in stories. I hope that by exposing both patients and healthcare providers to the finished work, I will be able to assess its effectiveness as a persuasive device, reflecting on the outcome as well as the process of the project: its promise, its pitfalls, and what we can hope to gain from it in the future.

Methods and Analysis

As a qualitative study, this project has two major components: the construction of a narrative that conveys the struggles of LGBTQ patients with the medical field in a socially responsible, non-appropriative manner; and evaluation of its effectiveness in reducing provider bias toward patients on the LGBTQ spectrum. Patients selected for the first phase of the project will be interviewed about their experiences and those experiences collected together to be utilized as inspiration for the narrative, which will be written as several vignettes to cover as much range of experience as possible. For the second phase, providers will be assessed for bias through both self-reporting measures and an Implicit Association Test, then re-evaluated after exposure to the narrative.

Ethics

As this project is utilizing the experiences of real patients, it is critical to not simply present their accounts as case studies €”and therefore pathologize their identities €”nor to use their experiences in an appropriative way, but instead to represent their voices and their accounts with as much veracity as possible. Accordingly, a COMIRB application will be filed to establish and codify the ethics of this process.

Primary Presenter: Adam Carroll

Project Title: *Quality of Life Improvements at One and Twelve Months Post-TAVR: Results from a Mixed Meta-Regression*

Primary Mentor: Dan Matlock, Geriatrics, Director of Colorado Program for Patient Centered Decisions

Secondary Mentor(s): Christopher Knoepke

Thematic Area: Clinical Science

Abstract:

#### BACKGROUND

TAVR is becoming the preferred treatment option for severe aortic stenosis. However, individual treatment decisions still hinge on the likelihood of quality of life (QOL) improvement, especially in the presence of comorbidities or need for alternative (non-transfemoral) access that may negatively impact these gains. Many patients with severe aortic stenosis (AS) have the option of transcatheter aortic valve replacement (TAVR). Individual treatment considerations hinge on the likelihood of improvements to quality of life (QOL), especially when uncertainty is amplified by the presence of comorbidities or the necessity of non-transfemoral approaches.

#### METHODS

Using PRISMA guidelines, we conducted an ongoing multi-database search for all English language studies of TAVR including QOL assessment at 1 and 12 months post-procedure. Studies were included if they were published from 2013 and used either the KCCQ or SF-12 as outcome measures. We performed a mixed-effects meta-regression of extant study data to determine whether short and long-term QOL improvements after TAVR differed according to patient surgical risk (inoperable, high, or intermediate) or access approach (transfemoral or alternate).

#### RESULTS

We identified 29 total studies meeting inclusion criteria. After removing analyses in overlapping cohorts, we were left with 15 unique cohorts composed of 4383 patients who received TAVR. Due to heterogeneity of variance, random effects models were fit, illustrating a consistent positive effect on QOL across studies, both at 1 month (log relative mean difference=-0.6, 95% CI: -0.91 to -0.37), and 12 months (lrmdd=-0.99, 95% CI: -1.25 to -0.73). At 1 month, QOL impact was moderated by alternate access use ( $p<.02$ ), but not surgical risk. At 12 mos, neither factor moderated improvements to QOL.

#### CONCLUSION

TAVR is consistently associated with improved QOL at 1 and 12 months post-procedure. Pooled analyses suggest that short-term QOL improvement is moderated by procedural approach, but not surgical risk, and longitudinal QOL is independent of both. Higher surgical risk and comorbidities modulate TAVR by decreasing baseline quality of life, however, longitudinal trends of improvement remain consistent with the trends found in pooled analyses. These data support the adoption of TAVR among patients with varied surgical risk and comorbidities, even in need for alternative access approaches.

Primary Presenter: Lakota Cheek

Project Title: *Literature Review: Smoking Cessation Initiation in the Emergency Department*

Primary Mentor: Allan Prochazka, Department of Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

Introduction

Smoking cessation has a host of benefits for patients especially with surgical interventions and cardiac issues (6, 9). The population that utilizes the Emergency Department (ED) has a statistically higher rate of tobacco usage and thus makes for a great population to target (19). The ED is a very challenging environment to give constructive interventions in limited amounts of time (1). This review aims to decipher some of the more effective methods to date to help shed light on how standard care should evolve. Unfortunately, ED physicians are skeptical to provide counseling to patients due to perceived time constraints and ineffectiveness of available methods (1, 11).

Methods

Literature review using electronic search on multiple online databases including but not limited to PubMed, EMBASE, and Psych Info. Eligible studies that pertain to the central question will be used to synthesize findings between the articles focused on adult ED smokers and primary initiation of cessation through the ED.

Results

Currently, ED initiation of therapy administered with booster communication provided by phone or text messages has the highest rate of utilization when combined with pharmacotherapy and referrals to outside clinics (13). Outside of having multiple interventions occurring at once the statistical significance for cessation and abstinence at 3, 6, and 12 months becomes insignificant (9). Other methods that might yield more benefit include having other providers in the ED give intervention with supplemental encounter with ED physicians to confirm the information after the intervention is given (8). Electronic guided interventions that occur in the ED and provide referrals to perceived beneficial care optimizes time for ED staff and has a higher rate of cessation initiation (16, 17). However, continued abstinence does not come with electronically guided care (3, 4, 9).

Conclusion

There is currently no agreed upon method for smoking cessation that provides sustained statistical benefit. However, the use of non-physician providers to deliver interventions and utilizing technology to begin the process increased rate of initiation may occur (4, 5, 11). Finally, booster communication seems like a worthy intervention worth trying (16). This review provides insight into practices done in the past and provides general recommendation for next steps in research.



Primary Presenter: Abigail Cher Kaye

Project Title: *The Donor Letter Project: Learning Professionalism and Fostering Empathy in an Anatomy Curriculum*

Primary Mentor: Therese Jones, Center for Bioethics and Humanities

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

While cadaver dissection remains an unmatched learning tool for structural anatomy, recent shifts in medical culture and pedagogy indicate that developing humanistic practices and fostering empathic responses are crucial components of early medical education. The Donor Letter Project (DLP) was designed to accompany a traditional dissection curriculum, and the pilot, described here, tested its quality and efficacy. In 2017, family members of recently deceased donors to the Colorado State Anatomical Board were invited to submit letters about their loved ones, and forty-seven first-year medical students at the University of Colorado School of Medicine volunteered to read the letters after their human anatomy course. The students then completed a survey about their experience. Because student and donor family responses to the DLP were overwhelmingly positive, the DLP will be repeated with incoming medical school classes, and an addendum to the State Anatomical Board donation application will invite donors to submit letters along with their enrollment materials that may be read by students at the time of donation.

Primary Presenter: Priya Chopra

Project Title: *FEED Aurora: Nutritional Education Effectiveness*

Primary Mentor: Liliane Diab, Department of Pediatric Nutrition

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Introduction

FEED Aurora is a nutrition-based pediatric program founded through an Innovations Award in 2016 by two first-year medical students. In recognizing a need for food resources and nutritional information in Aurora, FEED Aurora was designed to provide under-housed children with an opportunity to learn about food while eating nutritious meals. In continuing FEED Aurora programming, our leadership sought to understand the efficacy of our nutritional intervention within the Aurora, Colorado pediatric population.

Objectives

To determine if FEED Aurora 's nutritional interventions affect dietary and lifestyle choices in elementary school children.

Methods

A five-question survey was designed to be taken by the parent or legal guardian of children who participated in FEED Aurora programming during summer programming at the Colfax Community Network in 2017 and after-school programming at Crawford Elementary School during the 2017-2018 school year. Surveys printed in both English and Spanish were given to the children before and after our programming at both sites. Pre- and post-programming survey data were then collected and compared using unpaired t-tests to understand if FEED Aurora interventions resulted in any statistically significant difference in a child 's reported dietary habits.

Results

During the summer of 2017 at Colfax Community Network, 20 pre-programming surveys were collected. However, only 4 post-programming surveys were completed. During the 2017-2018 school year at Crawford Elementary, 9 pre-programming surveys were collected. However, only 4 post-programming surveys were completed. For Colfax Community Network, results indicate no statistical difference in reported consumption of soda per week (pre-survey mean 1.15, post-survey mean 1.0, p-value 0.6207), fruits (pre-survey mean 1.55, post-survey mean 1.5, p-value 0.9156), vegetables (pre-survey mean 1.35, post-survey mean 2.25, p-value 0.1685), or whole grains (pre-survey mean 2.05, post-survey mean 1.75, p-value 0.5686). Similarly, there was no statistical significance in willingness to try new foods (pre-survey mean 1.2, post-survey mean 1.5, p-value 0.5532). At Crawford Elementary School, there was no statistically significant difference in reported consumption per week of soda (pre-survey mean 0.67, post-survey mean 0.75, p-value = 0.7867), fruits (pre-survey mean 1.78, post-survey mean 1.75, p-value = 0.9659), vegetables (pre-survey mean 1.78, post-survey mean 2.0, p-value = 0.7251), or whole grains (pre-survey mean 1.78, post-survey mean 1.50, p-value = 0.6462). There was also no statistical significance in willingness to try new foods (pre-survey mean 1.78, post-survey mean 1.0, p-value = 0.2683).

## Conclusion

Many children within the city of Aurora experience significant food insecurity. FEED Aurora is a nutritional intervention that targets under-housed and minority youth within the Aurora community. Although nutrition interventions have been shown to have lasting impact within pediatric populations, organizing sustainable nutrition interventions requires significant funding, consistent and reliable staff, and community partnerships. While FEED Aurora worked to establish these supports, our leadership team experienced difficulties in securing sustainable funding and volunteers. Consistent turnover in medical student volunteers and community-partner leadership provided additional barriers to consistent FEED Aurora programming. Gathering survey data from our targeted population also posed several challenges in achieving adequate sample sizes. While our study sought to better understand the efficacy of FEED Aurora programming and interventions, we were unable to gather sufficient survey data in order to answer these questions. Limitations were inherent in our study, including our survey design, the young age of participants, socioeconomic barriers to reliably return surveys, limited class size at both intervention sites, a transient population of children, consistent turnover of survey distributors, and lack of buy-in from administrative staff at both sites. As FEED Aurora continues to work with Aurora youth on improving nutrition education and access to healthy meals, more work needs to be done in order to better understand the efficacy and long-term effects of FEED Aurora programming on the Aurora community.

Primary Presenter: Shayer Chowdhury

Project Title: *Disrupting Disparities: Using Enhanced Systems of Care to Improve Treatment Access and Outcomes for Children*

Primary Mentor: Katherine Grimes, Psychiatry

Thematic Area: Public Health and Epidemiology

Abstract:

The objective of my practicum project was to assess the impact of an integrated care delivery pilot (E-SOC) for children and adolescents, specifically with regard to patterns of service use, youth and family engagement, clinical functioning and total medical expense. When taken together, these results offer some preliminary “signals” related to cost-effectiveness of integrated care models between child psychiatry and pediatrics. Despite their increased risk of language barriers, within group, pre-post analyses for E-SOC youth revealed a 7-fold increase in level of engagement in child mental health treatment, year over year. Improvement in clinical functioning was also noted for intervention youth, from severe impairment down to mild-moderate impairment, across independent measures. Between group comparisons of claims data for E-SOC intervention youth, versus control group youth, demonstrated greater reductions in ED utilization for E-SOC study participants and larger declines in total cost-of-care.

Primary Presenter: Diana Clabots

Project Title: *Comparison Of Bacterial And Fungal Communities In Bronchoalveolar Lavage Using Small Subunit Ribosomal RNA*

Primary Mentor: Daniel Frank, Infectious Disease

Secondary Mentor(s): Jonathan Harris

Thematic Area: Basic Biomedical Science

Abstract:

Rationale

Cystic fibrosis (CF) is the most frequently inherited autosomal recessive life-shortening disease in people of European descent. Recurrent lung infections and the consequent inflammatory response in the lungs result in damage to the airways, the leading cause of morbidity and mortality in these individuals. The bacterial microbiota of the lungs in CF have been extensively characterized by culture and culture independent methodologies. Conversely, the fungi associated with CF have previously been analyzed almost entirely by culture. We hypothesize that analysis of the eukaryal microbiome by culture-independent methods will reveal a richer diversity of microorganisms than previously estimated with culture. Additionally, we hypothesize that eukaryal diversity will be increased during pulmonary exacerbation and that bacterial diversity will be higher than eukaryal diversity.

Methods

Bronchoalveolar lavage samples were collected from pediatric CF patients (N = 78) as well as disease control patients (N = 12 ) from 13 different institutions in the United States. DNA was extracted from the resultant lavage fluid. The eukaryal DNA from 90 patient samples was amplified using barcoded, broad-range 18S rRNA PCR primers. The pooled amplicons were sequenced on an Illumina MiSeq platform.

Results

Thirty three out of 90 samples were positive for fungal DNA. In total, one hundred and fifteen eukaryal taxa were detected by sequencing. Eleven (33%) of the fungal PCR positive samples were negative for fungi by culture. Of the samples that were positive by both methods, 18S PCR detected an average of 4.18 fungal taxa per sample while an average of 1.32 was detected by fungal culture. There was no difference in eukaryal alpha diversity (i.e., richness, evenness, Shannon Diversity) in individuals during pulmonary exacerbation compared to those with stable lung function. Furthermore, bacterial and eukaryal alpha diversities did not differ significantly within individuals.

Conclusions

A greater number of eukaryal taxa were detected by 18S rRNA PCR in the lungs of CF patients than previously demonstrated by culture. However, pulmonary exacerbation was not associated with increased eukaryal alpha diversity. Furthermore, comparable numbers of bacterial and eukaryal taxa were found in each individual, but this may be confounded by the limited number of samples.

Primary Presenter: Deanna Claus

Project Title: *Crisis Planning and Community Resource Navigation for Families of Individuals with Comorbid Neurodevelopmental and Behavioral Diagnoses within the Denver Community*

Primary Mentor: Cordelia Robinson Rosenberg, Professor Pediatrics and Psychiatry

Thematic Area: Public Health and Epidemiology

Abstract:

Previous research indicates that individuals with intellectual or developmental disabilities (I/DD) have an increased prevalence of mental health disorders. Individuals with comorbid I/DD and a mental health diagnosis are referred to as being “dually diagnosed.” Unfortunately, individuals with a dual diagnosis, and their families, suffer from poor or fractured access to mental health resources and often feel ill-equipped to navigate these supports when their mood or behavior gets out of control. Because of this, times of crisis often result in costly emergency room visits and hospitalizations.

This ongoing project was developed to produce crisis planning tools customized for children with a dual diagnosis. A Crisis Plan was created, as well as a complementary Resource Guide, to help families navigate the confusing array of mental health resources available in Colorado. This project began with a literature review, meetings with families of individuals with dual diagnosis, discussions with behavioral health providers, and collaboration with leaders of community mental health resources. When paired, these documents aimed to allow understanding of the interwoven system of available mental health supports, as well as planning for the appropriate utilization of each resource, based on each family 's unique circumstances.

Once both documents were finalized, a research project was initiated to test the efficacy of these tools. Details of the study protocol and plans for data collection are included. This research team remains optimistic that, because they are customized for the population with dual diagnosis, these tools have the potential to improve crisis severity, family sense of control, and decrease emergency service utilization.

Primary Presenter: Micah Cornett

Project Title: *Risk Factors for E-cigarette Use Among Latino High School Students*

Primary Mentor: Patricia Valverde, Colorado School of Public Health, Department of Community and Behavioral Health

Secondary Mentor(s): Fernando Holguin

Thematic Area: Public Health and Epidemiology

Abstract:

Significance: Vaping among adolescents is becoming an epidemic, with Colorado leading national vape use rates. Latino youth may be at increased risk for vape use initiation due to social factors. This study seeks to identify factors that increase the risk of vape use among Latino youth in Colorado. Methods: Data were analyzed from 8,601 Latino and 14,668 non-Latino students aged 12 to 18+ years participating in the 2017 Healthy Colorado Kids Survey. Variables included: gender (male/female), grade (9/10/11/12/Ungraded), vape use (none/light/heavy), tobacco use (none/light/heavy), marijuana use (non/light/heavy), binary alcohol use, communication with parent (YES!/yes/no/NO!), and household tobacco behaviors (smoke inside home 0-7 days). We calculated odds ratios and 95% confidence intervals using 2 multinomial logistic regression models to evaluate associations between behavioral and parental factors on vape use and compared the odds ratios of Latinos and non-Latino youth. Results: Among Latinos, 18.98% reported light and 7.22% reported heavy vape use; among non-Latinos, 17.31% reported light and 10.4% reported heavy vape use. Both Latino and non-Latino males reported heavier vape use while only Latino males showed increased odds of light vape use compared to females. Students who reported tobacco, marijuana, and/or alcohol use had a greater odds of vape use, regardless of ethnicity. However, Latinos who reported tobacco use had greater odds of vape use, compared to non-Latinos (Non-Latinos OR:5.05 CI:3.39-7.54  $p<0.05$ ; Latinos OR:10.01 CI:5.85-17.16  $p<0.05$ ). Parental factors appeared to have the most influence on Latino students. Latino students who could not ask their parents for help had a 2.79 (CI:1.82-4.29;  $p<0.05$ ) greater odds of being a heavy vape user. Additionally, Latino students living in homes with cigarette smoking showed increasing odds of being a heavy vape user as daily exposure to cigarette smoking increases (ORs:4.50, 11.86, 19.87, and 10.28;  $p<0.05$ ). Conclusion: Concurrent tobacco, marijuana, and alcohol use is associated with significantly higher odds of both light and heavy vaping among Latino and non-Latino students. Parental relationships and tobacco behaviors also appear to be influential factors, especially for Latinos. Vape prevention and treatment should target all high school students, particularly Latino male youth, and especially those with concurrent risky behaviors, low perceived parental support, and smoking within the home.

Primary Presenter: Ryan Cox

Project Title: *Cost analysis of community based weight loss intervention in Hispanic children in the northern Denver area*

Primary Mentor: Matt Haemer, Pediatrics - Department of Nutrition

Thematic Area: Public Health and Epidemiology

Abstract:

Background

Childhood overweight and obesity is a worldwide epidemic with many long-term health consequences. Societies have seen an increase in obesity-related comorbidities appearing earlier in life as childhood overweight and obesity have increased—notably type 2 diabetes, hypertension, hyperlipidemia, liver disease, and asthma. Studies have shown the benefits associated with weight management programs for children and long-term costs associated with overweight and obesity, although limited research exists demonstrating the short-term health care costs associated with overweight and obesity and its treatment. The current study sought to analyze health care costs for participants of a family-inclusive weight management intervention for overweight and obese youth.

Study design

A retrospective analysis of health care claims for participants of the Healthy Living Program who were insured by Colorado Access. Claims were collected for a 12-month period before the intervention start date and for a 12-month period after the intervention end date. Data included demographics, anthropometrics, medical claims, pharmaceutical claims. A paired t-test was used to assess the mean difference in changes in costs.

Results

Of 52 subjects originally included in the data set, 46 were included in the analysis after establishing an outlier cutoff at the 90th percentile of total health care costs per patient. The data were highly skewed, and variances were extremely large. Mean differences in total health costs were \$95 + 1062 (p=0.54), mean differences in laboratory and imaging costs were (-)\$6.80 + 154.6 (p=0.86), mean differences in mental and behavioral health costs were (-)\$46.10 + 1200 (p=0.88), and mean differences in pharmaceutical costs were \$12.60 + 80.30 (p=0.29).

Conclusions

Further investigation into the short-term costs associated with weight management interventions for overweight and obese youth are needed to develop a better understanding of health care costs associated with treatment programs. If policy changes with regards to insurance coverage for such weight management plans are to be sought, it will be critical to consider the cost perspective of the payer.



Primary Presenter: Graham Custar

Project Title: *A Literature Review of the Medical-Legal Partnership Model*

Primary Mentor: Jeremy Long, LEADS Track

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Medical-legal partnerships (MLPs) are an interdisciplinary method to address social determinants that impact downstream health outcomes for patients. Improving our ability to recognize and influence those social determinants can lead to financial and non-financial benefits for systems and patients, which has generated increasing interest among healthcare delivery systems and payors. The MLP model is a collaborative approach between lawyers and clinicians to achieve that goal. Although the model is not novel, it has been growing significantly in recent years as interdisciplinary care and preventive health have become more desirable and better funded. This review describes the history of and need for the MLP model, as well as patterns in successful implementation, current evidence of benefit, and what resources exist for establishing a partnership with legal resources within an existing healthcare delivery system.

Primary Presenter: Dani Dague

Project Title: *A Literature Review of the Medical-Legal Partnership Model*

Primary Mentor: Jeremy Long, LEADS Track

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Medical-legal partnerships (MLPs) are an interdisciplinary method to address social determinants that impact downstream health outcomes for patients. Improving our ability to recognize and influence those social determinants can lead to financial and non-financial benefits for systems and patients, which has generated increasing interest among healthcare delivery systems and payors. The MLP model is a collaborative approach between lawyers and clinicians to achieve that goal. Although the model is not novel, it has been growing significantly in recent years as interdisciplinary care and preventive health have become more desirable and better funded. This review describes the history of and need for the MLP model, as well as patterns in successful implementation, current evidence of benefit, and what resources exist for establishing a partnership with legal resources within an existing healthcare delivery system.

Primary Presenter: Taylor Davis

Project Title: *Community Perspectives on the Racial Disparity in Infant Mortality*

Primary Mentor: Janet Meredith, Family Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

**Objective**

The United States' infant mortality rate is significantly higher among infants born to non-Hispanic Black women than infants born to women of other races, independent of educational attainment or socioeconomic status. The purpose of this research was to understand conditions that lead to this disparity and propose practices for addressing them through community perspectives.

Method: Researchers conducted 6 focus groups with African American women who had been pregnant previously (n=27) and performed inductive thematic analysis looking the interaction between race and health.

**Results**

Major themes included barriers to quality healthcare and support. Women perceived that healthcare professionals provided substandard care based on implicit bias and felt that asking questions of providers led to loss of autonomy.

**Conclusions and Relevance**

The perceived quality of a woman's perinatal experience is affected by women's relationships with their healthcare providers, their social support, and their sense of autonomy in decision-making. To improve the relationships between African American women and their providers, participants expressed that racism and implicit bias must be recognized and addressed. While this should be addressed in individual interactions, this study also suggests the role of policy change and system-level modifications that should be considered to effectively decrease the racial disparity in infant mortality.

Primary Presenter: Jessica Demes

Project Title: *Use of Complementary Therapies for Chronic Pain Management in Patients with Hypermobility Spectrum Disorders*

Primary Mentor: Matthew Taylor, Anschutz Campus - School of Medicine – Cardiology, Adult Medical Genetics

Thematic Area: Clinical Science

Abstract:

**Purpose**

Ehlers-Danlos Syndromes (EDS) and Joint Hypermobility Syndromes (JHS) are debilitating connective tissue disorders that feature a prominent pain component for which there are limited therapeutic options for pain management. Consequently, many patients try various non-prescribed treatments. Our purpose was to provide the first comprehensive assessment of the use of complementary and alternative therapies in the EDS/JHS patient population.

**Methods**

We surveyed over 500 EDS and JHS diagnosed individuals to ascertain what complementary and alternative therapies were used and their reported effectiveness in alleviating pain and improving quality of life. Specifically, we focused on the use of traditional Chinese therapies, herbal and homeopathic medications, and marijuana.

**Results**

The most reported therapies, used by 70-92% of those surveyed, were Non-steroidal anti-inflammatory drugs, acetaminophen, opioids, and physical therapy. Therapies rated by participants as most efficacious were opioids, physical therapy, and marijuana with 10-24% of those using these therapies rating them as extremely helpful. Average pain was associated with both marijuana use (Odds ratio 1.085,  $p=0.007$ ) and traditional Chinese therapy use (Odds ratio 1.098,  $p=0.003$ ). Use of multiple therapeutic categories appears to underlie this association.

**Conclusion**

Patient-initiated complementary therapy use is widespread at 56%. Marijuana and traditional Chinese therapy were largely utilized by EDS and JHS patients with higher reported pain levels. Providers caring for EDS/JHS patients should be aware of these data showing broad usage of predominantly non-prescribed therapies and be prepared to consider such usage in developing comprehensive pain management plans.

Primary Presenter: Jaclyn DeRieux

Project Title: *GBS Biofilm Regulatory Protein A Contributes to Bacterial Physiology and Immune Resistance*

Primary Mentor: Rita Lee, Public health and epidemiology

Secondary Mentor(s): Dr. Victor Nizet, UCSD School of Medicine

Thematic Area: Basic Biomedical Science

Abstract:

#### BACKGROUND

*Streptococcus agalactiae* (group B *Streptococcus* [GBS]) asymptomatically colonizes approximately 20% of adults; however, GBS causes severe disease in susceptible populations, including newborns, pregnant women, and elderly individuals. In shifting between commensal and pathogenic states, GBS reveals multiple mechanisms of virulence factor control. Here we describe a GBS protein that we named "biofilm regulatory protein A" (BrpA) on the basis of its homology with BrpA from *Streptococcus mutans*.

#### METHODS

We coupled phenotypic assays, RNA sequencing, human neutrophil and whole-blood killing assays, and murine infection models to investigate the contribution of BrpA to GBS physiology and virulence.

#### RESULTS

Sequence analysis identified BrpA as a LytR-CpsA-Psr enzyme. Targeted mutagenesis yielded a GBS mutant ( $\Delta$ brpA) with normal ultrastructural morphology but a 6-fold increase in chain length, a biofilm defect, and decreased acid tolerance. GBS  $\Delta$ brpA stimulated increased neutrophil reactive oxygen species and proved more susceptible to human and murine blood and neutrophil killing. Notably, the wild-type parent outcompeted  $\Delta$ brpA GBS in murine sepsis and vaginal colonization models. RNA sequencing of  $\Delta$ brpA uncovered multiple differences from the wild-type parent, including pathways of cell wall synthesis and cellular metabolism.

#### CONCLUSIONS

We propose that BrpA is an important virulence regulator and potential target for design of novel antibacterial therapeutics against GBS.

Primary Presenter: William Dewispelaere

Project Title: *Improving Firearms Conversations in the Emergency Department*

Primary Mentor: Marian Betz, Emergency Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

Background

EM physicians interface with firearm violence while treating acute trauma and while intervening with patients at risk of future firearm injury or death. Interventions include counseling about firearm safety, which may be enhanced by provider firearm knowledge. Confusion about terminology and the legality of asking patients about firearms may contribute to physician discomfort discussing firearms. Firearms education may improve this, but physician-specific classes and materials are lacking. Here, we investigate the knowledge of EM physicians regarding firearms and the effect of a hands-on training course on this knowledge.

Methods

EM faculty and trauma surgeons from an urban hospital were invited to attend a half-day educational session at a firearm range. Lecture content included the epidemiology of firearm injury and an introduction to firearms from an NRA-certified instructor. Participants completed an anonymous assessment before and after the session. Six multiple-choice questions addressed knowledge about firearms safety, counseling, and legality. McNemar's Exact test was used to compare participants' response to each question in the pre-and post-test setting.

Results

26 people attended the event; 21 (81%) were ED providers. Most completed the pre- (n=23) and post- (n=21) session surveys. At baseline, 44% of attendees correctly defined a semi-automatic weapon; 35% of attendees confused the definition of fully automatic and semi-automatic. Half (43%) thought that, as of January 2018, it was illegal in some states for physicians to talk to patients about gun ownership or storage. After the event, most (71%) correctly defined a semi-automatic weapon, and almost all (91%) recognized that talking to patients about guns is legal in all states. Both the semi-automatic question and legality of counselling questions improved significantly on the post-session survey (p=0.0233; p=0.009, respectively)

Discussion

This study reinforces prior research and shows gaps in firearm knowledge among ED physicians. It also demonstrated that a short training event was an effective remedy for these gaps. Future studies should focus on the effects of firearms education on provider behavior and patient outcomes and the association between physician knowledge and the quality of firearm safety counseling.

Primary Presenter: Peter Doan

Project Title: *Temporal and Anatomic Relationship between Superficial and Deep Vein Thromboses in Hospitalized Children*

Primary Mentor: Brian Branchford, Pediatric Hematology, Oncology, and Bone Marrow Transplant

Thematic Area: Clinical Science

Abstract:

**Background**

Recent publications have increasingly demonstrated a link between superficial-vein thrombosis (SVT) and deep-vein thrombosis (DVT) in the adult population and have led to changes in SVT treatment considerations. A similar relationship between SVT and DVT in pediatric populations, however, is not currently well established.

**Objectives**

We sought to evaluate the temporal and anatomic relationship between SVT and DVT among pediatric inpatients in order to determine to if there is an association between SVT and DVT similar to the link found in the adult population. **Methods:** We first used a local DVT registry to retrospectively identify all children (age 0-21 years, inclusive) admitted to Children 's Hospital Colorado for more than 48 hours between January 2012 and September 2017 who developed a DVT while hospitalized. We then reviewed each patient 's electronic health record for evidence of SVT to identify SVT+DVT cases. Afterwards, we utilized a list of ICD codes to identify all patients during this time frame who developed an SVT and removed patients whom we previously identified as SVT+DVT cases to obtain the number of patients with isolated SVT.

**Results**

Of 59,988 subjects admitted during the study period, 438 (0.7%) developed a thrombosis while hospitalized - 197 (0.3%) with isolated SVT, 161 (0.3%) with isolated DVT, and 80 (0.1%) with both SVT+DVT. These 80 SVT+DVT patients represent 33% of the 241 total DVT subjects and 29% of the 277 total SVT subjects. The age breakdown for these 80 patients was: 2 (2.5%) 0-1 months, 14 (17.5%) 1 month-2 years, 26 (32.5%) 2-12 years, 15 (18.75%) 12-16 years, and 23 (28.75%) 16-21 years. 63 of the 80 (79%) SVT+DVT events were PICC-related. Of the 12 SVT+DVT subjects in whom the SVT was diagnosed before the DVT, the subsequent DVT occurred within a mean of 6.4 (range 1-22) days and at the same anatomic site in 6 (50%).

**Conclusions**

Our results indicate a temporal and anatomic relationship between SVT and DVT in hospitalized children, particularly those with central venous catheters.

Primary Presenter: Erin Drake

Project Title: *The association between immediate postpartum etonogestrel implants and positive postpartum depression screens in adolescents*

Primary Mentor: Kristina Tocce, OB/GYN

Thematic Area: Clinical Science

Abstract:

**Background**

Immediate postpartum implant placement has been shown to be a highly effective form of contraception among adolescents. While the use of immediate postpartum implants is becoming more common, there remains uncertainty surrounding the association between immediate progestin contraception and postpartum depression.

**Objectives**

We compared rates of positive postpartum depression screens at six weeks postpartum among adolescents initiating immediate postpartum contraceptive implants and those initiating other methods.

**Study Design**

We assessed prenatal and postpartum depression among patients enrolled in an adolescent pre and postnatal program. Depression was assessed at prenatal intake using the Center for Epidemiologic Studies Depression (CES-D) scale and postpartum with the Edinburgh Postnatal Depression Scale (EPDS). We compared rates of prenatal (CES-D  $\geq 24$ ) and postpartum (EPDS $>10$ ) depression between the immediate postpartum implant and comparison group.

**Results**

Four hundred ninety-seven patients were enrolled between January 2013 and December 2016: median age was 19 (range: 13-22 years); 86% were primiparous, 50% were Latina, 24% were black and 16% were white; 34% of the cohort initiated immediate postpartum implants (n=169). Those initiating immediate postpartum implants were similar to the rest of the cohort in baseline characteristics, aside from an increased rate of preterm births among the immediate postpartum implant group (19.4% vs. 12.1%; p=0.03). Prenatally, 14% had an elevated CES-D (11.5% immediate postpartum implants vs 15.4% comparison, p=0.25). At six weeks postpartum, 7.6% had a positive postpartum depression screen; this rate was significantly lower for those initiating immediate postpartum implants compared to those choosing other methods (4.1% vs. 9.5%, p=0.04).

**Conclusions**

Immediate postpartum implant use was associated with a lower rate of positive EPDS screens when compared to use of any other contraceptive method in the immediate postpartum period. Providers should continue to encourage adolescent mothers to choose whichever highly-effective contraceptive method they prefer for postpartum use.



Primary Presenter: Amanda Ellgen

Project Title: *Communication and adherence in migraine treatment guidelines*

Primary Mentor: Lisa Keranen, Communications

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Migraine is a burdensome and costly condition for millions of patients worldwide. Medical research has developed many treatments for migraine, but adherence levels fall below desirable rates. Enhanced communication techniques have been found to be effective in increasing treatment adherence in migraine patients. This study investigates the integration of communication interventions into migraine treatment guidelines. A communication-focused content analysis of major treatment guidelines from professional associations will reveal to what extent communication interventions appear in major treatment guidelines and will inform recommendations for improving migraine treatment adherence rates.

Primary Presenter: Elizabeth Empey

Project Title: *Smartphone Use for Ophthalmological Imaging in the Emergency Department*

Primary Mentor: David Richards, Emergency medicine

Thematic Area: Clinical Science

Abstract:

Vision impairment affects 1.3 billion people worldwide, a number which is expected to increase with the continued increase in population growth and ageing. The highest burden of disease occurs in low-income, low-resource settings, where ophthalmologic equipment is often inaccessible for evaluation. With the smartphone becoming a commonplace tool in the hands of physicians, this presents a unique opportunity to take advantage of smartphone imaging capabilities in order to facilitate ophthalmologic evaluations and remote consultations, and in turn increasing access to vision screening. Three ophthalmologic imaging techniques are presented here for which smartphone technology can be applied: external ocular imaging, fundoscopic imaging, and slit lamp imaging. Techniques are presented in order of increasing cost, ranging from optimization of hand-held smartphone images alone, to utilizing specialized smartphone and slit lamp adapters available for purchase. These smartphone images increase the quality and efficiency of documentation, analysis, and sharing for remote consultation services. Use of this technology has the potential to increase screening outreach by decentralizing delivery of ophthalmologic services, and thus increasing access to vision screening in the low-resource settings where ophthalmologic disease burden is often highest.

Primary Presenter: Joshua Ferreri

Project Title: *The January 2013 Beijing "Airpocalypse" and its acute effects on emergency and outpatient visits at a Beijing hospital*

Primary Mentor: Brooke Anderson, Environmental and Radiological Health Sciences

Secondary Mentor(s): Dawn Comstock

Thematic Area: Public Health and Epidemiology

Abstract:

Severe air pollution episodes in Europe and the USA in the early- to mid-twentieth century caused large health impacts, spurring national legislation. Similarly severe episodes currently affect developing regions, as exemplified by a particularly extreme episode in January 2013 in Beijing, China. We investigated associations between this episode and medical visits at a Beijing hospital. We obtained fine particulate matter (PM<sub>2.5</sub>) measurements from the US State Department's Embassy monitor and daily counts of all-cause, cardiovascular, and respiratory emergency visits, and outpatient visits from a nearby hospital in the Liufang Nanli community. We analyzed whether risks increased during this episode (with daily PM<sub>2.5</sub>  $\geq 350$   $\mu\text{g}/\text{m}^3$ ) using generalized linear modeling, controlling for potential confounders. The episode brought exceptionally high PM<sub>2.5</sub> (peak daily average, 569  $\mu\text{g}/\text{m}^3$ ). Risk increased during the episode for all-cause (relative risk 1.29 [95% CI 1.13, 1.46]), cardiovascular (1.55 [0.90, 2.68]) and respiratory (1.33 [1.10, 1.62]) emergency medical visits, and respiratory outpatient visits (1.16 [1.00, 1.33]). Relative risks of all-cause (0.95 [0.82, 1.10]) and cardiovascular (0.83 [0.67, 1.02]) outpatient visits were not statistically significant. Results were robust to modeling choices and episode definitions. This episode was extraordinarily severe, with maximum daily PM<sub>2.5</sub> concentration nearly 22-fold above the World Health Organization guideline. During the episode, risk increased for all-cause, cardiovascular, and respiratory emergency medical visits, and respiratory outpatient visits, consistent with previous US-based research. However, no association was found for all-cause or cardiovascular outpatient visits. China-based studies like this one provide critical evidence in developing efforts regarding air pollution remediation in China.

Primary Presenter: Kirk Fetters

Project Title: *Integrase Inhibitor-Containing Therapy in Pregnancy: Infant and Fetal Outcomes*

Primary Mentor: Christiana Smith-Anderson, Pediatric Infectious Diseases

Secondary Mentor(s): Dr. Smith, Adriana Weinberg

Thematic Area: Clinical Science

Abstract:

**Background**

The use of antiretrovirals (ARV) during pregnancy has dramatically decreased HIV perinatal transmission. However, ARV have occasionally been associated with maternal and fetal severe adverse events. Protease inhibitors (PI), nucleoside/nucleotide reverse transcriptase inhibitors (NRTI) and non-NRTI (NNRTI) have been well studied, but less is known about integrase inhibitors (INSTI), which became available after the year 2007. We compared the incidence of congenital malformations and adverse birth outcomes in pregnancies exposed to INSTI- vs NNRTI- or PI-containing ARV.

**Methods**

Retrospective review of the pregnancies managed at a single site between 2008 and 2018. For twin gestations, the infant with the least severe outcome was excluded. Logistic regression was used to model the relationship between any congenital anomaly and in utero exposure to any INSTI, and dolutegravir (DTG) specifically, compared with PI or NNRTI taken together. Wilcoxon rank sum test was used to compare rates of preterm birth between groups. Significance was set at  $p < 0.05$ .

**Results**

Among 257 pregnancies, 77 women received  $\geq 1$  INSTI (54 dolutegravir, 11 elvitegravir, 13 raltegravir), 177 received  $\geq 1$  PI or NNRTI (no INSTI), and 3 had missing data. At delivery, women had median (IQR) 30 (26;34) years; 560 (384;728) CD4 cells/ $\mu$ l; and  $< 20$  ( $< 20$ ;25) HIV RNA copies/ml. Deliveries occurred at 38 (37;39) weeks gestational age and included 126 vaginal; 123 Cesarean; and 4 unknown. There were 1 spontaneous abortion, 3 stillbirths and 41 preterm births. After excluding 10 twins, 253 neonates had 2988 (2640;3295)g birthweight, 128 male sex, 66 Hispanic ethnicity, and 141 black race. Fifty-six congenital anomalies were identified among 39 infants (21% musculoskeletal, 20% craniofacial, 16% cardiac, 14% cerebrospinal, 13% genitourinary, 16% other). Among INSTI-exposed infants, 18 (23%) had congenital anomalies compared with 20 (11%) among NNRTI- or PI-exposed (OR=2.40; 95%CI=1.19-4.84;  $p=0.01$ ). Among DTG-exposed infants, 13 (24%) had congenital anomalies (OR = 2.49; 95% CI=1.14-5.42,  $p=0.02$ ). One stillbirth occurred in an INSTI-exposed infant. There were no differences in rates of preterm birth between INSTI-exposed and NNRTI- or PI-exposed infants.

**Conclusions**

In utero exposure to INSTI-containing regimens, particularly DTG, may be associated with increased rates of congenital anomalies.

Primary Presenter: Jacob Fox

Project Title: *Chronic Kidney Disease in the San Luis Valley of Colorado and Its Relation to Tungsten Exposure*

Primary Mentor: Kathy James, Department of Environmental and Occupational Health, Colorado School of Public Health

Thematic Area: Public Health and Epidemiology

Abstract:

#### Background

Chronic kidney disease is a significant cause of morbidity and mortality in agricultural communities around the world. The San Luis Valley (SLV) is a rural agricultural community in south central Colorado with a heavy burden of chronic disease, a high prevalence of CKD, a history of prolonged drought, and a water supply contaminated by heavy metals. Due to their geographic, sociodemographic, and climate-change-related environmental risk factors, it is hypothesized that heavy metal exposure could be related to CKD amongst inhabitants of the SLV.

#### Methods

We obtained pre-existing sociodemographic, clinical, and urine trace metal data for 1690 subjects from the San Luis Valley Diabetes Study (SLVDS) cohort. We restricted the study population to three subgroups (n = 1,659, 816, and 620, respectively) in which we assessed the associations between urine tungsten (W) and renal injury markers, time-to-CKD, and CKDu. Subjects were analyzed by descriptive statistics, and targeted multiple logistic regression was performed to evaluate hypothesized risk factors for CKDu.

#### Results

This is the first study of CKD in a diverse rural agricultural population in Colorado, and among the first studies of the association of renal injury biomarkers and urine W, and of CKDu in the U.S. In our study population, elevated urine W was strongly associated with decreased time-to-CKD, even after controlling for hypertension and diabetes. Regardless of how CKD indeterminate subjects are treated, a doubling of urine W was associated with a 27 to 31% higher odds of developing CKD within 5 years. In addition, elevated urinary W was significantly associated with CKDu, but not AKIu, in dichotomous 95%ile exceedance models. While there was no significant relationship between urine W and urine NGAL or KIM1, we report that the effect of urine W on urine NGAL is modified by diabetes status. Conclusions: Our data suggest that increased exposure to W decreases time-to-CKD and may be associated with CKDu. Given persistence of associations after controlling for diabetes and hypertension, W may exert a primary effect on the kidney. Further studies are needed to assess the relationship of urinary W to longitudinal environmental data in the SLV, and to define a “safe” level of W in the water supply.

Primary Presenter: Amy Franks

Project Title: *The Youth Community Health Awareness Partnership: Community-based participatory research initiative to assess the scope of alcohol use within the community of refugees from Burma in the greater Denver area*

Primary Mentor: Janet Meredith, Department of Family Medicine

Secondary Mentor(s): Jamaluddin Moloo, Departments of Medicine and Radiology

Thematic Area: Public Health and Epidemiology

Abstract:

#### BACKGROUND

For more than fifty years, minorities in Burma have faced severe persecution and violence that has forced them to flee their homeland. In the past ten years there has been an influx in the number of refugees resettled in Denver. Refugees often struggle to navigate the complexities of the American health care system and adapt to life in a foreign culture. The development of novel programs and partnerships to assist refugees in their pursuit of health and integration is essential to build stronger, cohesive communities.

#### METHODS

Beginning in 2014, a multi-phase community based participatory research (CBPR) project was developed in collaboration with the refugee community from Burma residing in the greater Denver area. The first phase of the project involved establishing a partnership with the community. A group of motivated teenagers and young adults from this community collaborated to form our Youth Advisory Board (YAB). We met regularly with the YAB to discuss and prioritize health issues. They identified alcohol use and misuse as the paramount health concern within their community. Formative information was elicited from community leaders, local refugee organizations, healthcare providers, and informal surveys to guide future research tools. With this identified issue, the project moved into phase two of data collection. Phase two involved conducting formal one-on-one, semi-structured, audio-recorded interviews with community members. Participants were recruited voluntarily at health information nights held by the student researchers at their local apartment complex. The interviews were conducted by one medical student researcher with one translator present and were transcribed afterward. Phase three, the current phase of the project, includes data analysis and presenting our findings to the community. The interview data was analyzed using Immersion Crystallization methodology. This data will be leveraged to create, implement, and evaluate a culturally competent intervention to effectively address risky alcohol use in this affected community.

#### RESULTS

Initial results from the nineteen meetings with the YAB, fourteen meetings with local organizations, nineteen formative community surveys, and three key informant interviews pointed to the vulnerability of the refugee population, the scarcity of culturally appropriate resources for alcohol abuse, and the urgency of addressing problematic alcohol use. The analysis of the ten audio-recorded surveys showed the emergence of several themes related to the use of alcohol within this community. Themes identified through qualitative analysis include negative consequences of alcohol use, specifically negative impacts

on familial relationships, employment, and financial resources, and a perceived personal responsibility for managing one 's own alcohol consumption.

#### CONCLUSIONS

This project corroborates current literature regarding the scope and breadth of hazardous alcohol use within the community of refugees from Burma. Our data has expanded our understanding of the values of community members including the influence of religion and family on behaviors, and the negative impact on employment as the most impactful negative consequence. These findings need to be shared with the community to move forward in mapping the most effective and appropriate interventions.

Primary Presenter: Stephanie Fukui

Project Title: *Inflammation Strikes Again: Frailty and HIV*

Primary Mentor: Kristine Erlandson, Medicine - Infectious Disease

Thematic Area: Clinical Science

Abstract:

**Purpose of Review**

As a consequence of antiretroviral therapy, the proportion of older HIV-infected adults is increasing, with a concomitant shift in burden of illness to age-related syndromes and disease. Frailty is an age-related syndrome of increased vulnerability to stress, predictive of major adverse clinical outcomes among HIV-infected and uninfected persons alike. Understanding frailty pathogenesis is critical to developing interventions to improve health outcomes in HIV. Here, we review the current evidence for the relationship between inflammation and frailty in HIV, and the potential for novel, inflammation-targeted interventions.

**Recent Findings**

Dysregulated inflammation has been consistently associated with frailty in elderly HIV-uninfected persons. Dysregulated inflammation is also central to HIV pathophysiology and several recent studies have demonstrated the important association of inflammation with frailty in HIV. Some evidence suggests that anti-inflammatory therapies may be effective in ameliorating the adverse impact of frailty among aging HIV-infected adults, though further investigation is necessary.

**Summary**

Inflammation has been implicated in frailty in HIV infection, and improved understanding of the role that inflammation plays in frailty pathogenesis is key to the development of effective therapies to slow or prevent frailty in the vulnerable HIV-infected population.



Primary Presenter: Derek George

Project Title: *What Does Fatigue Mean to Persons Living with Parkinson's Disease? A Qualitative Investigation including Validation of Proposed Case Definition Criteria*

Primary Mentor: Benzi Kluger, Neurology

Thematic Area: Clinical Science

Abstract:

#### Introduction

Fatigue is one of the most prevalent and debilitating non-motor symptoms of Parkinson's disease (PD) strongly associated with decreased quality of life. Research into this enervating symptom has been hampered by the lack of a standardized case definition of PD-related fatigue and the use of inexact terminology. To lay a foundation for future phenomenological study, our goals were to elicit the experiences of persons living with PD-related fatigue and to begin the validation process for previously proposed case definition criteria.

#### Methods

Semi-structured qualitative interviews were conducted with 22 individual participants and 4 focus groups (N = 29). Interview transcripts were analyzed using an inductive qualitative method. Demographic and quantitative clinical scale data were also recorded to better characterize our participants.

#### Results

Six core themes emerged from our interviews: 1. Difficulty initiating important tasks and being productive; 2. Desire for others to understand the experience of fatigue; 3. Heterogeneity of patient experiences and descriptions of fatigue; 4. Complex relationships with other non-motor symptoms; 5. Variable self-management strategies; 6. General alignment with proposed case definition criteria. Conclusions: PD-related fatigue results in significantly decreased function and quality of life, is subjectively distinguishable from other non-motor symptoms, manifests as heterogeneous symptoms, and may be mitigated by various self-management strategies. Proposed case definition criteria are mostly ecologically valid, and future validation of case definition criteria is warranted.

Primary Presenter: Declan Grabb

Project Title: *Provider Directory for LGBTQ Patients*

Primary Mentor: Rita Lee, Department of Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

It is evident that some physicians are uncomfortable treating LGBTQ patients, which leads LGBTQ patients to avoid seeking healthcare, which serves to exacerbate existing health disparities. Furthermore, there is little mandated training for medical students, residents, and attending physicians in LGBTQ healthcare. As such, LGBTQ patients are often at a disservice, as they are often unable to find affirming, competent healthcare providers who have been trained in a standardized, effective format. For this reason, a literature review was conducted in order to identify the specific health disparities that exist within the LGBTQ population. These data were extrapolated to inform which specialists would be necessary to include in a provider directory for LGBTQ patients. The primary literature and the real world are very different arenas for healthcare and advocacy; therefore, three centers known for LGBTQ healthcare were spoken with in order to ascertain the most effective methods of serving this population. They identified specific training programs that have been effective in equipping physicians with the tools to service this population, and they highlighted what has and has not worked for them in terms of a provider directory and LGBTQ patient navigators. These data were synthesized in order to create an evidence-based and realistic formulation for what a provider directory should look like for individual hospital systems, regardless of location.

Primary Presenter: Andrei Gurau

Project Title: *Investigating Ventriculostomy Associated Infection: A Challenging Task due to Documentation Variance*

Primary Mentor: Jaime Baker, Colorado Springs Faculty

Secondary Mentor(s): No

Thematic Area: Clinical Science

Abstract:

#### Introduction

Ventriculostomy associated infections (VAI) affect 5-20% of patients that have an external ventricular drain (EVD) placed. VAI results in 10 additional ICU days and 8.5 additional hospital floor days as well as a 168,692-dollar increased cost in the hospital stay. Since the 1990s there has been an increased focus on preventing VAIs, and there are myriad measures and interventions that have been shown to reduce VAIs; concomitantly, more hospitals are implementing these measures and some going as far as to protocolize these measures for the patients with EVDs at their facilities.

#### Objectives

Systematically compile a list of best practices for EVD deployment and maintenance measures that from studies where the primary endpoint is the reduction of VAI incidence. Endeavor to determine the extent that these measures were performed as well as the overall variance in the documentation of these measures over all EVDs placed at our academic affiliated community-based hospital.

#### Methods

After a systematic review of literature, the EVD deployment and maintenance measures that reduced VAI were compiled. A retrospective review of electronic health record and billing code data from 32 different EVDs placed at our academic affiliated community-based hospital during calendar year 2018 was performed. Data extracted was the overall percentages of each VAI prevention measures being performed over the course of 32 EVDs and the percentages the respective measures were documented within the EHR.

#### Results

EVD Deployment and Maintenance measures that prevent VAI. EVD deployment measures that lead to reduced incidence of VAI were: one prophylactic antibiotic dose prior to placement, aseptic placement, clipping of hair at surgical site, cleansing of procedure site with chlorhexidine or povidone-iodine, use of antibiotic eluting catheter, tunneling of catheter, and use of a chlorhexidine eluting patch at EVD exit site. The measures that were identified as best practices for EVD maintenance: continuous antibiotics, twice weekly or less CSF sampling frequency, no routine catheter exchanges, and EVD duration less than 10 days. EVD Deployment and Maintenance Measure prevalence and documentation In CY 2018 the percentage of VAI reduction measures over 32 EVD deployments were as follows: use of one prophylactic antibiotic dose prior to placement: 71.875%, aseptic placement: 100%, clipping of hair at surgical site 45.2%, cleansing of procedure site with chlorhexidine or povidone-iodine: 100%, use of antibiotic eluting catheter: 59.375%, tunneling of catheter: 100%, and use of a chlorhexidine eluting patch dressing at EVD exit site: 9.375%. In CY 2018 the percentage of the deployment measures that

were even documented over 32 EVD deployments were as follows: use of one prophylactic antibiotic dose prior to placement: 100% documented, aseptic placement: 87.5% documented, hair removal modality 68.75% documented, cleansing of procedure site with chlorhexidine or povidone-iodine 53.1% documented, use of antibiotic eluting catheter: 34.4% documented, tunneling of catheter: 93.8% documented, and type of dressing over EVD exit site: 25% documented. In CY 2018 usage of optimal EVD maintenance over 32 EVD deployments were as follows: continuous antibiotics 59.375%, twice weekly or less CSF sampling frequency 0%, CSF leak monitoring with 100% of EVDs, no routine catheter changes 100%, and EVD duration less than 10 days 62.5%. In CY 2018 the percentage of the variables of interest under maintenance measures that were even documented over the duration of 32 EVDs were as follows: continuous antibiotics 100% documented, twice weekly or less CSF sampling frequency 100% documented, CSF leak monitoring 62.5% documented, no routine catheter changes 0% documented, and EVD duration less than 10 days 100% documented.

### Conclusion

VAIs are associated with increased length of stay and cost of stay. There are clear measures to be taken to reduce VAI. Many of these key measures are commonly used, however there are some measures that could be utilized more. Furthermore, key factors for VAI need a more systematic documentation in order to have a complete understanding of what measures are being performed and which are not in order to perform an analysis to determine what needs to be done in order to reduce VAIs at our hospital. This will lead to reduced VAI incidence and a reduction in the associated costs.

Primary Presenter: Lakotah Hardie

Project Title: *Multiplexed measurement of DNA repair capacity for tumor heterogeneity*

Primary Mentor: Jay Hesselberth, Molecular Biology

Secondary Mentor(s): No

Thematic Area: Basic Biomedical Science

Abstract:

#### PURPOSE OF STUDY

Mutations in DNA repair factors can lead to development of cancer, and many cancer treatments target DNA repair to cause cell death. We hypothesize that biochemical differences in DNA repair activities may underlie cellular heterogeneity in tumor and cancer pathologies. The goal of this project is to develop a novel assay to measure the DNA repair capacities of cancer cells and to apply it to individual cells in a population.

#### METHODS USED

The assay uses DNA hairpin substrates with different DNA damage events located to each hairpin. Individual hairpins targeting different repair pathways within the cell can be ligated to magnetic beads to test a majority of DNA repair pathways within the cell in a multiplexed fashion. To this end, bead immobilized DNA repair substrates were incubated with bulk cell lysate and products of DNA repair were recovered by bead isolation. PCR amplification and Illumina sequencing were then used to identify repair activities. Bioinformatic pipelines systematically compared differences in repair profiles across conditions in the optimization of the assay with ATP regeneration and chemotherapy pre-treated cells. Future directions will include the combination of a microfluidic platform for single cell analysis.

#### SUMMARY OF RESULTS

I tested whether an ATP regeneration system improves the signals in the assay. Inclusion of a creatine phosphokinase (CPK) ATP regeneration system increased capture across all repair pathways as compared to controls. We identified significant increases in Nucleotide Excision Repair (NER) and mismatch repair (MMR) that were not seen in the absence of the ATP regeneration system. Pre-treatment of cells with Temozolomide, a clinically useful DNA alkylating agent, demonstrated increased repair activities in Direct Reversal-mediated repair of methylated adducts compared to positive controls.

#### CONCLUSIONS

The addition of an ATP regeneration system significantly increased capture of repair events by increasing local concentrations of ATP to support cellular enzyme activities. Increases in repair activities were seen across all pathways tested. DNA damaging pretreatments indicated predictable upregulations in certain DNA repair pathways matching the type of DNA damage event generated.

Primary Presenter: Margaret Harrison

Project Title: *The Youth Community Health Awareness Partnership: Community-based participatory research initiative to assess the scope of alcohol use within the community of refugees from Burma in the greater Denver area*

Primary Mentor: Janet Meredith, Department of Family Medicine

Secondary Mentor(s): Jamaluddin Moloo, Departments of Medicine and Radiology

Thematic Area: Public Health and Epidemiology

Abstract:

#### BACKGROUND

For more than fifty years, minorities in Burma have faced severe persecution and violence that has forced them to flee their homeland. In the past ten years there has been an influx in the number of refugees resettled in Denver. Refugees often struggle to navigate the complexities of the American health care system and adapt to life in a foreign culture. The development of novel programs and partnerships to assist refugees in their pursuit of health and integration is essential to build stronger, cohesive communities.

#### METHODS

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#### RESULTS

Initial results from the nineteen meetings with the YAB, fourteen meetings with local organizations, nineteen formative community surveys, and three key informant interviews pointed to the vulnerability of the refugee population, the scarcity of culturally appropriate resources for alcohol abuse, and the urgency of addressing problematic alcohol use. The analysis of the ten audio-recorded surveys showed the emergence of several themes related to the use of alcohol within this community. Themes identified through qualitative analysis include negative consequences of alcohol use, specifically negative impacts

on familial relationships, employment, and financial resources, and a perceived personal responsibility for managing one 's own alcohol consumption.

#### CONCLUSIONS

This project corroborates current literature regarding the scope and breadth of hazardous alcohol use within the community of refugees from Burma. Our data has expanded our understanding of the values of community members including the influence of religion and family on behaviors, and the negative impact on employment as the most impactful negative consequence. These findings need to be shared with the community to move forward in mapping the most effective and appropriate interventions.

Primary Presenter: Brittany Hartman

Project Title: *Colorado in the Crossroads: Stakeholder Perspectives on Over-the-Counter Status of Oral Contraceptive Pills*

Primary Mentor: Carol Stamm, Department of Medicine/Obstetrics and Gynecology

Secondary Mentor(s): No

Thematic Area: Public Health and Epidemiology

Abstract:

#### BACKGROUND

In 2009, Colorado implemented a unique policy aimed at reducing unintended pregnancies. This policy is known as the Colorado Family Planning Initiative (CFPI). The CFPI provided funding to women's health clinics to allow them to provide Long Acting Reversible Contraceptives (LARCs) to women at no or very low cost. This program was widely hailed as a success, and it dramatically reduced the rates of unintended pregnancies and abortions, including decreasing the teen pregnancy rate by nearly 40% between 2009 and 2015. However, 2015 was a turning point for the CFPI, as Colorado's legislature failed to pass a bill aimed at renewing state funding for this highly successful program. A temporary stop-gap funding measure from charitable sources allowed this program to continue functioning, but without the same assurances of state government funding. This program once again came under threat in 2019, when federal policies clashed with women's healthcare through new restrictions put in place by the Department of Health and Human Services. These new restrictions stated that clinics that received Title X federal funding to help provide preventative health services for low-income and uninsured individuals could not receive funding if the clinic was housed in the same location as abortion providers, and that healthcare providers could not even refer women for abortion services if their clinic received Title X funding. These types of threats to funding for women's healthcare services are not new and occur even in the face of dramatically successful programs aimed at reducing abortion and teen pregnancy. By threatening to defund both the CFPI program and Title X clinics, thousands of women, perhaps as high as 30,000 in the state of Colorado alone could lose access to affordable contraceptive services. Given the uncertainty of contraceptive coverage in this state, novel approaches to allow women to access these services must be attempted. One proposed solution may be to approve oral contraceptives for over-the-counter (OTC) use. Although this is not a novel concept, it has never been studied in this state. The idea of OTC contraceptives has received widespread support from the medical community, but has been met with considerable resistance from other stakeholders, including policymakers, for unclear reasons. The purpose of this study was to understand stakeholder perspectives on the idea of placing contraceptives over-the-counter in the state of Colorado.

#### METHODS

A questionnaire with focused questions regarding stakeholder perspectives was submitted for IRB approval, and was granted approval for both phone and in-person interviews. Qualitative personal interviews were then conducted with 62 participants. Participants were recruited to represent diverse stakeholder perspectives including religious leaders, healthcare organizations, health insurance leaders, legislative representatives, and healthcare professionals. Interviews were conducted in person or over the phone. Interview questions focused on stakeholder readiness for, barriers to, and professional



support for or resistance to OTC contraceptives in CO. Descriptive content analysis was then used to categorize data into themes organized by question.

## RESULTS

Across stakeholder groups, most participants felt that Colorado was ready for OTC contraceptives, citing the state's progressive legislative history, from the passage of the CFPI to marijuana deregulation. Among all stakeholder groups, contraceptives were felt to be a commonly prescribed medication with well-known side effects. Yet, there was no clear stakeholder consensus on whether contraindications placed on labels would be followed, and many participants offered education-based or label change solutions to this perceived barrier. All groups of stakeholders had concerns regarding possible cost increases and the potential for dropped insurance coverage of the medication were oral contraceptives to be placed OTC. Religious and/or political barriers were also cited as a concern, particularly amongst religious leaders. There was some conflict and no clear consensus on support or opposition from the health insurance and religious leader stakeholder groups.

## CONCLUSIONS

Although many participants felt that Colorado is ready for over-the-counter contraceptives, there were several barriers identified. Potential for cost increases, especially the potential for lost insurance coverage, was the most consistently mentioned concern. Stakeholders also noted concern for missed opportunities for preventative health screenings. Overall, the data suggest that there is support for continued insurance coverage of oral contraceptives, although there was no consensus on the best approach to continued coverage. Findings from this study may provide strategies for implementing over-the-counter oral contraceptives in a way that addresses the needs and concerns of key stakeholders in the state.

Primary Presenter: Travis Hays

Project Title: *Upgrading Multiple-Choice Question Items in Cardiovascular, Pulmonary, Renal Block to Meet National Board of Medical Examiners Standards*

Primary Mentor: Daniel Goldberg, Family Medicine

Secondary Mentor(s): Dr. William Sather

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

An important step in earning medical licensure in the United States is passing Step 1, a United States Medical Licensing Examination (USMLE) exam used to assess medical knowledge and clinical skills. USMLE Step 1 items are written by the National Board of Medical Examiners (NBME), an organization that provides item-writing guidelines for crafting medical school course exam items. Qualitative guidelines include a list of exam writing errors classified as technical errors and errors of testwiseness. Quantitative guidelines provide standards for statistical indices used to measure exam item quality. The goal of our study is to assess the impact of item revision based on NBME item-writing guidelines on item quality and student exam performance. Two cardiovascular exams were modified items and administered during the 2018 Cardiovascular, Pulmonary, and Renal (CVPR) systems course at the University Colorado School of Medicine. Psychometric parameters such as item discrimination, difficulty, and reliability were used to compare the item quality of 2017 and 2018 exams. The results suggest that exam revisions improved the item quality of the CVPR exams by increasing item discrimination and decreasing the number of items with negative item discrimination while maintaining exam reliability. By improving the item quality, we aim to better assess the clinical knowledge of students and prepare students for NBME-style questions on USMLE Step 1. In the future, exam data of subsequent years and student USMLE Step 1 scores should be analyzed to explore the effect of improving item quality on USMLE Step 1 scores.

Primary Presenter: Mario Hernandez

Project Title: *Middle School to Medical School (M2M): An outreach program developed and implemented on the Anschutz Medical Campus encouraging underrepresented in medicine (URM) middle school students to pursue careers in medicine*

Primary Mentor: Deborah Seymour, Department of Family Medicine

Office of Inclusion and Outreach (second mentor specified below)

Secondary Mentor(s): Dominic Martinez EdD, Senior Director, Office of Inclusion and Outreach

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

#### Background

Despite Affirmative Action Health Care Policy efforts, the diversity of the U.S. population is not reflected in the composition of the student body, medical school faculty, or physician workforce. Minority groups make up 30% of the U.S. population, but only 13% of medical students, 6% of physicians, and 3% of medical school faculty are members of an underrepresented minority groups.<sup>1</sup>

Research studies demonstrate that increasing the number of URM medical students and practicing physicians, enhances learning outcomes, improves cultural competency, and helps eliminate healthcare disparities.<sup>2,3</sup> Many of the existing medical school pipeline and mentoring programs are focused on high school and undergraduate students, while little research has been done on the impact of these programs on middle school students. <sup>4,5</sup>

#### Program Goals

The program was created to allow sixth, seventh, and eighth grade students from historically underrepresented backgrounds to engage with a diverse group of medical students and participate in a series of medically-focused enrichment activities on the Anschutz Medical Campus (AMC). The goals of the program were: (1) to encourage a positive attitude towards higher education; (2) to increase interest and encourage URM students to pursue a career in a health profession; (3) to increase confidence and self-efficacy in pursuing any health care career; and (4) to increase students' confidence and self-efficacy in specifically becoming a physician.

#### Data Collection

Anonymous pre-and-post evaluation surveys were implemented and completed by the participants to help guide future iterations of the program, to provide insight on program effectiveness and impact, and to help inform the development of similar outreach programs. The pre-and-post surveys featured a quantitative section focused on assessing the participant's interest in pursuing medicine or another health care career, sense of self-efficacy in pursuing such health care careers, and belief that other students of the same race/ethnicity could become health professionals. These survey questions were asked on a 5-point Likert scale, from 1=Strongly disagree to 5=strongly agree. The post-survey also collected qualitative feedback using open-ended questions on what the students enjoyed and did not enjoy about the program, as well as their recommendations for improvement. Quantitative data from the 2019 iteration of the Middle School to Medical School (M2M) program were analyzed using paired two-sample t-tests, with P-values provided as applicable. Qualitative data were reviewed and coded into themes using a manual thematic analysis.

## Results

After participating in the Middle School to Medical School (M2M) program, the middle school students had increased interest and self-efficacy in pursuing careers in medicine and other health professions. The students expressed increased agreement with the statement that they are interested in becoming a medical doctor (3.3 pre vs. 3.6 post). The students also expressed significantly greater interest in becoming health care providers other than doctors (3.1 pre vs. 3.4 post,  $p < 0.05$ ). Finally, the students showed improved self-efficacy in reporting significantly greater confidence in possessing the knowledge needed to become a medical doctor (3.5 pre vs. 3.9 post,  $p < 0.05$ ). In reviewing the program evaluation responses, overall the majority of participants expressed enjoyment of the program with 77% stating that they would recommend the program to a friend. A few of the workshops were particularly well received including the Anatomy Lab, Campus Tour, and Ultrasound Workshop. The percentages of participants who indicated on a 5-point Likert scale that they at least "Somewhat" to "Very Much" enjoyed those activities were 100%, 94.4% and 88.9% respectively.

## Future Direction

In future iterations of our program, we plan to tweak a few of our workshops to improve the program day flow. This includes having our student panel include students from other professional schools besides medical school and asking our panelists to tailor their advice and responses to a middle school audience. We will also devise a way for our Jeopardy Game to be less competitive between the students and more inclusive as a way to reiterate what they have learned throughout the day. We also hope to include more middle school students in future iterations of our program to not only expand our outreach program, but also to add more validity to our data.

Primary Presenter: Ryan Hirata

Project Title: *A Cross-Sectional Study of Knowledge, Attitudes, and Practices Surrounding Exclusive-Breastfeeding at Dhulikhel Hospital, Nepal*

Primary Mentor: Jennifer Bellows, EM

Thematic Area: Global Health

Abstract:

**Background**

Rates of malnutrition and stunting in Nepal are among the highest in the world. Exclusive breastfeeding, defined as giving an infant only breast milk without any food or liquid supplementation, is known to be protective against stunting and is recommended by the World Health Organization (WHO) until an infant is six months of age. Few studies have addressed the lack of exclusive breastfeeding (EBF) as a contributing factor to malnutrition and stunting in Nepal. The objective of this research study was to determine knowledge, attitude and intentions to exclusively breastfeed of pregnant women receiving care at the Antenatal Clinic at Dhulikhel Hospital in the Kavre District of Nepal.

**Methods**

A cross-sectional survey was conducted among 302 pregnant women that attended the antenatal clinic at Dhulikhel Hospital in Nepal from June to August 2015. The quantitative questionnaire was created from a survey used to evaluate barriers to EBF in Zimbabwe, with additional questions based on the Behavioral Theory Model. Data set is categorical and was statistically analyzed using Fisher 's Exact Test.

**Results**

Knowledge of exclusive breastfeeding recommendations, belief of ability to produce sufficient breast milk, and perception of the necessity for infant supplementation influenced mothers ' decision to discontinue exclusive breastfeeding. Most women reported healthcare workers as influential in their decision to breastfeed, whereas local community and familial attitudes had little influence on mothers ' decisions.

**Conclusion**

Lack of knowledge of the definition of exclusive breastfeeding is prevalent among pregnant women receiving care at Dhulikhel Hospital. The belief that infants require supplemental food or formula appears to have a particularly influential impact on cessation of exclusive breastfeeding within the first six months of an infant 's life. Interventions driven by health-care workers have the potential to influence the intentions regarding exclusive breastfeeding in pregnant women in Nepal.

Primary Presenter: Kellen Hirsch

Project Title: *Stabilization of Hypoxia Inducible Factor Improves Lung Structure and Function and Prevents Pulmonary Hypertension in an Antenatal Model of Bronchopulmonary Dysplasia*

Primary Mentor: Steven Abman, PEDS Pulmonary and Sleep Medicine

Thematic Area: Basic Biomedical Science

Abstract:

#### Purpose

Bronchopulmonary dysplasia (BPD), the chronic lung disease of prematurity, is characterized by arrested lung structure and function and high risk for pulmonary hypertension (PH). Animal models suggest that decreased angiogenesis impairs lung growth and causes PH. Hypoxia-inducible factor (HIF) is a key regulator of angiogenesis but whether enhanced HIF signaling could prevent BPD is uncertain, especially in an antenatal model of lung injury. Therefore, we sought to determine if antenatal and postnatal HIF stabilization preserves lung growth and function and prevents PH in a rodent model of chorioamnionitis-induced BPD.

#### Methods

Endotoxin (ETX, 10ug/sac) was administered to pregnant rats by intra-amniotic (IA) injection at embryonic day 20 (E20; term = E23) and pups were delivered by cesarean-section at E22. Dimethyloxallylglycine (DMOG), a prolyl hydroxylase inhibitor, was administered to sustain HIF signaling at either E20 (antenatal therapy, 10mgs/sac at E20) or after birth (postnatal therapy, 5 mg/kg every other day by IP injections for 14 days). At day 14, animals were killed to collect lung tissue to assess alveolarization by radial alveolar counts (RACs); pulmonary vessel density (PVD) by endothelial staining for von Willebrand Factor; and cardiac weights to determine right ventricular hypertrophy (RVH; ratio of RV to LV+S weights) as an indicator for pulmonary hypertension (PH). Lung protein contents of HIF and vascular endothelial growth factor (VEGF) were determined by western blot. In some rats, lung function was determined by Flexivent measurement of compliance and resistance at day 14. Results As compared to controls, IA ETX: decreased RAC by 42% ( $p < 0.01$ ), decreased PVD by 41% ( $p < 0.01$ ), increased RVH by 70% ( $p < 0.01$ ), increased lung resistance by 46% ( $p < 0.01$ ), and decreased lung compliance by 41% ( $p < 0.01$ ). Antenatal and postnatal DMOG therapy restored all values to control levels with the exception of lung compliance in the postnatal treatment. By western blot analysis, DMOG increased lung HIF-1 $\alpha$  and VEGF protein expression by 4- and 3- fold above values measured after ETX exposure alone ( $p < 0.01$  for each protein).

#### Conclusion

We found that antenatal or postnatal DMOG therapy improves lung structure and function and prevents RVH caused by antenatal ETX exposure. We speculate that the beneficial effects of DMOG therapy are due to HIF stabilization and up-regulation of VEGF expression in the developing lung

Primary Presenter: Clarinda Hougen

Project Title: *Using whole exome sequencing of peripheral blood tumor markers to optimize immunotherapy choice in metastatic melanoma*

Primary Mentor: Eduardo Davila, Medicine, Medical Oncology

Secondary Mentor(s): Breelyn Wilky, Andrew Kent

Thematic Area: Clinical Science

Abstract:

Immune checkpoint inhibitors targeted for blockade of cytotoxic T-lymphocyte antigen-4 (CTLA-4) and programmed cell death (PD-1) pathways have allowed for significant advancements in treating metastatic melanoma. However, only a subset of patients has been observed to derive a meaningful and lasting response, and it is often difficult to predict who these patients will be. In this study, we aim to show that immune responders can be selected for through sampling of peripheral blood to identify specific genetic markers that will allow us to predict successful reactivation of immune surveillance mechanisms. This ability to identify responsive patients will improve individualization of melanoma therapies.

Primary Presenter: Thatcher Houldin

Project Title: *What Do Popsicles Have To Do With Being a Doctor: Developing a LIC Medical Student Empathy Curriculum*

Primary Mentor: Jaime Baker, Internal Medicine

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

**Background**

Empathetic care for patients has a host of positive clinical outcomes for the patient, health care provider and society. However, the national level of empathetic healthcare providers is inadequate. Empathy can be taught and needs to be emphasized in undergraduate medical training especially during the core clinical year. The Colorado Springs Branch at the University of Colorado Medical school is responsible for the core clinical year for twenty students but lacks an empathy curriculum.

**Methods**

Using Kern's 6-step approach to curriculum development, we developed a multifaceted curriculum to increase empathy in third-year medical students at the Colorado Springs Branch.

**Results**

Our curriculum is composed of the following educational components: (1) viewing of the film "Wit" followed by a personal reflection exercise, (2) active learning didacts on physician burnout followed by resilience skills practice, (3) a flipped classroom session on the impact of bias in medicine, and (4) storytelling by students to mitigate emotional exhaustion. The educational content was designed from evidence-based best practices in the current literature on medical empathy training. We also propose a methodology to measure the effectiveness of this curriculum.

**Conclusion**

Using Kern's framework, we implemented a new curriculum at the Colorado Springs Branch at the University of Colorado intending to foster empathy through advanced educational techniques surrounding the humanities, burnout prevention, and recognition of bias.



Primary Presenter: Robert Hoyt

Project Title: *Morphological Changes of Leukocytes as a Marker for Sepsis: A Systematic Review*

Primary Mentor: Julie Rosser, Pathology

Thematic Area: Basic Biomedical Science

Abstract:

Background

Sepsis has high prevalence and mortality, yet is difficult to diagnose clinically despite the aid of laboratory tests. Modern hematology analyzers can evaluate presently unreported data on leukocytes that may provide additional useful information to providers making treatment decisions. This paper seeks to review the evidence on use of leukocyte cell population data (CPD) as an aid to the early detection of sepsis.

Data Sources

Pubmed and EMBASE were searched using keywords related to sepsis and CPD. Study appraisal and synthesis: The author personally reviewed and sorted abstracts for relevance. Cytomorphometric data was of primary interest. Papers dealing exclusively with fluorescence-based tests, or with delta index, were excluded.

Results

For Beckman-Coulter analyzers, changes in mean neutrophil volume (MNV), mean monocyte volume (MMV), and the respective distribution widths (NDW, MDW), were most reliably correlated with sepsis in adults. In pediatric patients, MNV and NDW, specifically, were most useful. In contrast, on Sysmex analyzers, in adults, neutrophil forward light scatter, which correlates with volume, is not significant in any study collected. Rather, neutrophil fluorescence intensity is more reproducible and performs better as a predictor of sepsis. No pediatric studies with Sysmex analyzers were found.

Conclusions

Beckman-Coulter and Sysmex analyzers detect apparently paradoxical CPD parameter changes in septic patients, which require elucidation. Enough evidence may exist to prospectively set cut-off values for parameters of interest in future studies.

Primary Presenter: Kristina Hulen

Project Title: *Efficacy of Helmet Heads Helmet Safety Curriculum in Colorado Schools*

Primary Mentor: Lauren Rhoades, Family Medicine

Secondary Mentor(s): Dr. Bruce Evans

Thematic Area: Public Health and Epidemiology

Abstract:

Helmet safety is crucial to promoting health and wellness in American youth. Head injuries related to bicycling are common and can result in significant morbidity and mortality; however, head injuries are preventable with helmet use. There is limited federal and local support for helmet use in Colorado, and communities face many barriers to helmet use, including legislation, peer and parent influence, knowledge of proper helmet use, socioeconomic status, and age. Helmet Heads is a Colorado non-profit that addresses these barriers by working with children at a young, impressionable age, in Title 1 schools across Denver and Aurora. Helmet Heads uses a well-defined school-based curriculum to provide education on helmet safety and proper helmet use, as well as providing free fitted helmets to every student.

An evaluation tool must be developed to provide feedback and to ensure the effectiveness of the helmet safety curriculum. This evaluation tool will be a survey administered before and after the Helmet Heads helmet safety curriculum is presented and will assess helmet safety knowledge and helmet use preference. We hypothesize that the Helmet Heads helmet safety curriculum will result in increased educational scores for helmet safety and improved personal preference to wear a helmet when riding a bicycle, skates, scooter, or skateboard as compared to no curriculum in second-grade students in Title 1 schools in Denver, Aurora, and Jefferson County, Colorado. This project is currently being submitted to COMIRB for approval and will take place in Spring 2020. With this information, we hope to continue to improve our community program and make helmet safety part of the curriculum for children in Colorado.

Primary Presenter: Anastasia Hunt

Project Title: *Time-Based Assessment of Hearing Preservation Rates after Microsurgical Resection of Vestibular Schwannomas: A Systematic Review*

Primary Mentor: Sam Gubbels, Otolaryngology

Thematic Area: Clinical Science

Abstract:

#### OBJECTIVE

To determine short- and intermediate-term hearing preservation rates after microsurgical resection of vestibular schwannoma (VS).

#### DATA SOURCES

Systematic review of the Ovid, Cochrane, EMBASE, and Web of Science databases.

#### STUDY SELECTION

This study was restricted to full text English language articles detailing VS resection via the middle cranial fossa (MCF) or retrosigmoid (RS) approaches. Documentation of pre- and post-treatment hearing outcomes with AAO-HNS, Gardner-Robertson (GR), or word recognition score (WRS) scales, as well as time to follow-up were required. Duplicate data sets, studies with >10% of patients with neurofibromatosis 2, prior or non-surgical VS treatment, case reports with <5 patients, or studies detailing decompressive surgery were excluded.

#### DATA EXTRACTION

Two authors independently performed full text reviews to determine study eligibility. Discrepancies were settled by consensus. "Class A/B, I/II" hearing was defined as AAO-HNS Class A or B, GR Class 1 or 2, or PTA  $\leq$  50 dB with WRS  $\geq$  50% on audiogram.

#### DATA SYNTHESIS

Pooled estimates of preserved Class A/B, I/II hearing at last post-operative follow-up.

#### CONCLUSIONS

Of 1,323 reports, 14 were utilized in analyses yielding data from 2977 patients. Mean follow-up was 52.5 months (SD = 19.9). Class A/B, 1/2 hearing was preserved at last follow-up in 57% of patients. Meta-regression revealed that resection through the MCF was associated with preservation of serviceable hearing. Moreover, when preserved in the immediate post-operative period, it appears to be stable over time.

Primary Presenter: Matthew Hupy

Project Title: *SMAD7 mediated suppression of epithelial to mesenchymal transitional markers in lens*

Primary Mentor: J. Mark Petrash, Ophthalmology

Thematic Area: Basic Biomedical Science

Abstract:

**Purpose**

Posterior capsular opacification (PCO) is the most common complication of cataract surgery. PCO is a result of TGF- $\beta$ -induced fibrosis in which residual cells undergo epithelial-to-mesenchymal transitions (EMT), yielding cells with a myofibroblastic morphology. Our prior tissue culture studies demonstrated that aldose reductase (AR) plays a noncatalytic role in TGF- $\beta$ -signaling in LEC, and that LEC from AR transgenic mice (ARTG) demonstrate elevated levels of TGF- $\beta$ -signaling through the Smad pathway leading to EMT. The inhibitory SMAD7 has been reported to suppress TGF- $\beta$ -induced Smad signaling and EMT in non-ocular tissues. In this study, we investigated the efficacy of SMAD7 in suppressing EMT in lens using both cell culture and in vivo cataract surgery models.

**Methods**

An enhanced version of SMAD7 used in these studies was engineered to contain a Tat-peptide to facilitate cell penetration (confirmed by immunofluorescence) and was purified from E. coli host cultures. Primary lens epithelial cells from ARTG mice were examined by western blotting for EMT markers following treatment with TGF- $\beta$ 2 and our enhanced SMAD7. The ability of SMAD7 to influence EMT was also evaluated in an extracapsular lens extraction (ECLC) model performed in ARTG mice. Five days after ECLC, RNA from lens capsules was used in QRT-PCR assays to measure transcript levels of EMT markers such as  $\alpha$ -smooth muscle actin ( $\alpha$ -SMA) and fibronectin (FN).

**Results**

Exposure to TGF- $\beta$ 2 led to a 40% increase in  $\alpha$ -SMA in LEC cultured from ARTG mice. Addition of SMAD7 completely prevented the TGF- $\beta$ 2-induced increase in  $\alpha$ -SMA. Levels of gene transcripts for the EMT markers  $\alpha$ -SMA and FN were elevated in ARTG lens capsules following ECLC, but were decreased by 41% and 26%, respectively, when SMAD7 was introduced into the capsular bag at the time of lens extraction surgery.

**Conclusions**

SMAD7 reduces EMT markers as shown by TGF- $\beta$ 2 induction of  $\alpha$ -SMA in cultured LECs. SMAD7 reduces the induction of EMT markers  $\alpha$ -SMA and FN following ECLC surgery in mice. We hypothesize that suppression of the Smad pathway through the use of an enhanced version of SMAD7 is a potential strategy for reducing the onset and progression of PCO following cataract surgery.

Primary Presenter: Derek Jones

Project Title: Racial/Ethnic Differences in Barriers to Kidney Transplant Evaluation Among Hemodialysis Patients

Primary Mentor: Jessica Kendrick, Internal Medicine

Thematic Area: Kidney transplant, health disparities

Abstract:

#### Background

Only a small percentage of dialysis patients receive a transplant and this is particularly the case for racial/ethnic minorities. Our objective was to identify barriers to initial transplant evaluation in our dialysis centers.

#### Methods

We conducted a survey of adult hemodialysis patients from 4 dialysis units in the Denver Metro area in 2016. Participants completed an 11-item survey with demographic information and questions regarding time on dialysis, if a provider ever spoke to them about transplant and whether they had been evaluated for a transplant. Reasons for not having an evaluation were explored. Descriptive statistics, chi-square analyses and multivariate analyses were used to examine the responses.

#### Results

167 patients completed the survey (response rate 63.9%). The majority of participants were male and were Hispanic (49%) or Non-Hispanic Black (31.7%). 140 patients (84.0%) reported discussing kidney transplantation with their doctor but only 53% reported having a transplant evaluation. After adjustment for age, gender and time on dialysis, significantly fewer Blacks reported having an evaluation than Non-Hispanic whites or Hispanics (43.4% vs. 57.7% (Whites) and 59.7% (Hispanics))  $p=0.03$ . The most frequent responses of the patients who had not been evaluated were: not referred by their provider (46%), did not know how to proceed (43.4%) or did not understand the benefits (39.5%) or transplant process (38.2%). Compared to Non-Hispanic whites, Blacks and Hispanics reported less understanding of the benefits and process of transplant.

#### Conclusion

Timely referral by providers and improved kidney transplantation education may reduce disparities in access to kidney transplantation.

Primary Presenter: Katherine Jankousky

Project Title: *A Feasibility Study of an Adolescent Inpatient LGBTQ+ Identities Group*

Primary Mentor: C. Sloan Burton, Psychiatry

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

We completed a feasibility study of a four-session psychoeducation group focused on LGBTQ identities at an inpatient adolescent psychiatric unit. Materials were adapted from tools used in high school and college settings, as well as DBT modules. Group participants included cisgender, heterosexual, queer, genderqueer, and questioning patients ranging from 10 to 17 years of age. The four sessions focused on: (1) LGBTQ identities, (2) intersectional identity formation, (3) empathizing with and sharing stories of gay and trans identity formation, and (4) self-exploration and goal setting. Patients were surveyed on the extent to which they learned about LGBTQ identities, their own identities, and to what extent the session was helpful to their treatment using a 1 to 5 (disagree to agree) Likert scale (averaged preliminary ratings ranged from 3.7 to 4.1 on these items). Participants also provided comments on the group that are of value for future developments and iterations of this group. Overall, patients reported having learned information and found the group helpful to their treatment. Multiple groups of patients reached beyond the goals of the group. For example, some participants connected stigma experienced by LGBTQ folks to stigma experienced by those holding psychiatric diagnoses. A full-targeted needs assessment is recommended as the next step in implementing a sustainable curriculum on intersectional LGBTQ identities for patients in inpatient adolescent psychiatry units.

Primary Presenter: Trevor Janus

Project Title: *Perioperative Troponin Analysis: Review and Current Implications*

Primary Mentor: Steven Morozowich, Anesthesiology

Thematic Area: Clinical Science

Abstract:

If mortality in the perioperative period were considered a distinct category by the Centers for Disease Control and Prevention, it would annually constitute a leading cause of death in the United States ([1] (#\_ENREF\_1)). Perioperative mortality related to myocardial injury after surgery (MINS), defined as biochemical evidence of ischemia-related myocardial injury occurring within 30 days of surgery, is emerging in the literature ([2] (#\_ENREF\_2)). The cause of MINS is most often due to type II myocardial demand ischemia, as opposed to an acute coronary syndrome ([3] (#\_ENREF\_3)). Further, the majority of these perioperative patients do not experience ischemic symptoms, possibly due to residual anesthetic/analgesic effects, and thus the identification of myocardial injury with troponin analysis is appealing in this population. However, despite sensitive or high sensitivity troponin analysis being readily available to detect MINS, a definite management strategy for MINS has not been defined to date, and as a result significant controversy exists regarding the true value and clinical relevance of perioperative troponin analysis ([4-6] (#\_ENREF\_4)).

Primary Presenter: Beza Jobira

Project Title: *Exploring the relationship between the gut microbiome and puberty in youth girls at risk for type 2 diabetes (T2D).*

Primary Mentor: Melanie Cree-Green, Department of Pediatrics, Division of Endocrinology

Secondary Mentor(s): Daniel Frank, MD, Megan Kelsey, MD

Thematic Area: Clinical Science

Abstract:

**Objectives**

Pediatric-onset T2D is twice as common in girls vs. boys and is tightly linked with puberty and obesity. Alterations in gut microbiota, specifically the Firmicutes:Bacteroidetes ratio (F:B), may be associated with insulin sensitivity (Si) and may play a role in the pathophysiology of T2D. We aimed to evaluate associations between gut microbiome composition and Si and insulin secretion in obese prepubertal (PP) vs. late-pubertal (LP) girls.

**Methods**

Obese PP (N=9, age 8.5 ±0.8 yr, BMIz 2 ±0.5) and LP (Tanner 4-5, N=9, age 13 ±2 yr, BMIz 2 ±0.5) girls underwent stool collection and intravenous glucose tolerance testing after an overnight fast. High-throughput sequencing of the bacterial 16S rRNA gene V3-V4 region was used to profile fecal bacterial communities. Bergman 's minimal model was used to estimate Si and insulin secretion (acute insulin response to glucose, AIRg) and disposition index (DI). T-tests assessed group differences in Si, AIRg and DI. Spearman 's correlation examined correlations between microbiota relative abundance (%RA) and Si, AIRg and DI.

**Results**

PP vs. LP girls had significantly higher Si ( $8 \pm 1$  vs.  $2 \pm 0.5 \times 10^{-4} / \text{min}^{-1} \mu\text{U}/\text{ml}$ ,  $p < 0.001$ ) and DI ( $3,525 \pm 636$  vs.  $1,687 \pm 385 \times 10^{-4} / \text{min}^{-1}$ ,  $p = 0.03$ ). AIRg was not significantly different between PP and LP girls ( $568 \pm 132$  vs.  $840 \pm 174 \mu\text{U}/\text{ml}$ ,  $p = 0.23$ ). F:B ratio was negatively correlated with insulin secretion and DI, respectively ( $R = -0.32$ ,  $p = 0.20$ ;  $R = -0.39$ ,  $p = 0.11$ ) but not Si. At the genus level, Si was significantly correlated with Ruminococcus and Lachnospira %RA ( $R = 0.53$ ,  $p = 0.02$ ;  $R = 0.50$ ,  $p = 0.036$ ). AIRg was significantly correlated to Peptostreptococcaceae %RA ( $R = -0.48$ ,  $p = 0.045$ ). DI was significantly correlated with Prevotella and Bifidobacterium %RA ( $R = 0.57$ ,  $p = 0.01$ ;  $R = -0.54$ ,  $p = 0.02$ ).

**Conclusion**

These pilot study results suggest possible relationships among the gut microbiome, glucose metabolism, and puberty in girls at risk for T2D that merit further exploration.



Primary Presenter: Jared Johnson

Project Title: *Factors affecting lymph node sampling patterns and the impact on survival of lymph node density in patients with Wilms tumor: A Surveillance, Epidemiology, and End Result (SEER) database review*

Primary Mentor: Nicholas Cost, Urology

Thematic Area: Clinical Science

Abstract:

#### Background

Lymph node (LN) involvement is an important prognostic indicator for patients with Wilms tumor (WT), and there have been previous reports of utilizing LN density (LND = positive LN/LNs examined) as an advanced metric to risk-stratify patients with WT.

#### Objective

The purpose of this study was to describe patient characteristics that affect LN yield and assess the effect of LND on OS in patients with WT, with the expectation that patients with LNDs above the median would demonstrate lower OS.

#### Study Design

The Surveillance, Epidemiology, and End Result (SEER) database was queried for all patients diagnosed with unilateral WT from 2004 - 2015. Patient and disease characteristics were collected, and Poisson regression was used to identify characteristics correlated with LN yield. LND was calculated for LN-positive patients and multivariable survival analysis was performed including patient demographics and LND as variables.

#### Results

1,489 patients with unilateral WT were identified for analysis, 231 (15.51%) of whom were LN-positive. Median patient age at diagnosis was 3-years (IQR 1 - 5). On Poisson regression, year of diagnosis, patient age, tumor size and laterality, and stage were found to impact LN yield. For patients with positive LNs, 5-year OS of patients with LNDs above the median (0.38) was worse than those below the median (81.9% vs 92.2%,  $p=0.045$ ). On multivariable analysis, only tumor size remained a significant predictor of OS.

#### Discussion

Administrative databases such as SEER provide an excellent resource for studying conditions where large patient numbers for analysis are difficult to obtain. Unfortunately, the SEER database is unable to account for every factor that could affect LN sampling patterns. Additionally, favorable vs unfavorable histology is not available in SEER, and SEER utilizes its own staging system, which makes comparison to Children's Oncology Group staging difficult. Despite these limitations, the findings of this study are similar to those previously published using administrative databases analyzing LN sampling patterns and the effect of LND on OS in WT.

#### Conclusions

Analysis of the SEER database confirms that there are several patient and disease specific factors that affect the number of LNs sampled during nephrectomy for WT and that LND may be a predictor of OS. These findings highlight the need for standardization of LN sampling patterns for pediatric renal tumors and support the investigation of LND in future studies to further risk-stratify WT patients in order to tailor therapy intensity.

Primary Presenter: Alexander Jones

Project Title: *ACL Injury Severity and Long-Term Functional Outcomes*

Primary Mentor: Jay Albright, Orthopedic Surgery

Thematic Area: Clinical Science

Abstract:

Background

Anterior cruciate ligament (ACL) rupture is the most common injury of the internal knee in the pediatric population. Despite investigative efforts long-term functional outcomes after ACL rupture remain universally unpredictable. The purpose of this study was to investigate the prognostic value of concomitant injury on long term functional outcomes and return to play (RTP) duration.

Methods

A retrospective cohort study of pediatric subjects who sustained a complete ACL tear. All subjects were confirmed to have a complete ACL rupture by MRI and were treated at Children 's Hospital Colorado by a single board-certified pediatric sports medicine orthopedic surgeon. All subjects achieved appropriate fixation by arthroscopic ACL reconstruction using quadriceps tendon autograft. The severity of the injury was defined by the occurrence of concomitant injury to the ipsilateral knee which was extracted from pre-operative MRI and arthroscopic findings in the operative note. Two validated surveys, International Knee Documentation Committee (IKDC) and Lysholm Knee Questionnaire, were administered to subjects that were at least 2 years post-reconstruction to assess functional outcomes. Return to play time was calculated as the time from reconstruction to return to play clearance noted in the patient record.

Results

A total of 129 (66 female) subjects met the inclusion criteria for the study. The majority (85%) had sustained any type of concomitant injury. The most common injury was one or multiple meniscal tears (87/129; 67%) followed by any chondral injury (65/129; 50%). Multiple concomitant injuries of any type had lower IKDC ( $94.2 \pm 0.7$ ) and Lysholm ( $94.2 \pm 0.9$ ) scores than the non-concomitant injury group ( $95.8 \pm 0.9$ ;  $p < 0.05$ ) ( $99.0 \pm 0.5$ ;  $p < 0.05$ ). RTP time was increased in the multiple concomitant injury group ( $10.9 \pm 0.5$  months) compared to non-concomitant injury group ( $9.0 \pm 0.7$  months) ( $p < 0.05$ ). Concomitant combined medial and lateral meniscal tears were associated with lower IKDC scores ( $87.2 \pm 2.9$ ) compared to knees without any meniscal tears ( $95.4 \pm 0.7$ ) ( $p < 0.05$ ). Concomitant lateral compartment chondral injury of any grade had decreased IKDC scores ( $91.1 \pm 1.3$ ;  $p > 0.05$ ) and Lysholm scores ( $91.6 \pm 1.7$ ;  $p < 0.05$ ), and increased RTP time ( $11.1 \pm 0.8$ ;  $p < 0.05$ ) compared to non-concomitant chondral injury knees. Any concomitant fracture was associated with decreased IKDC ( $92.0 \pm 1.3$ ;  $p < 0.05$ ) and Lysholm scores ( $93.1 \pm 1.7$ ;  $p < 0.05$ ) compared to ACL injuries without concomitant fracture knees ( $95.0 \pm 0.5$ ) ( $97.6 \pm 0.4$ ).

Conclusion

The severity of the injury defined by concomitant injury to the ipsilateral knee is prognostic of worse functional outcomes at least two years after ACL reconstruction. Specifically, two or more concomitant injuries (meniscal, ligamentous, chondral, fracture) are associated with worse functional outcomes and increased RTP duration. Combined medial and lateral meniscus tears, lateral compartmental chondral injury, or any kind of fracture is associated with worse functional outcomes. This study can be used to

educate patients and their families and manage expectations with long-term functionality and return to sport duration if they sustained concomitant injury.

Primary Presenter: Alex Joufflas

Project Title: *Indications for Revision Total Hip Arthroplasty: Referrals to a Tertiary Care Facility*

Primary Mentor: Michael Dayton, Orthopedics

Secondary Mentor(s): Dr. Craig Hogan

Thematic Area: Clinical Science

Abstract:

Introduction

Total hip arthroplasty (THA) is a dependable surgery with a ten-year success rate of 90% (2). Some individuals require revision (THR) for hip instability, aseptic loosening of hardware, infection, periprosthetic fracture, pain, osteolysis and implant failure. Indications for revision are known at a national level but not at the University of Colorado Hospital (UCH). The aim of the study is to identify the indications and type of revision performed for THR at UCH between patients who had their primary procedure done at UCH versus outside hospitals (OSH).

Methods

A retrospective chart review of all patients who underwent THR by two fellowship trained arthroplasty surgeons between the years of 2012 and 2017 at UCH was performed. Student 's t test and the Chi-squared test and, when appropriate, Fisher 's exact test, bivariate analyses were conducted to analyze the differences between hospital groups.

Results

Age at time of revision was statistically significant at 65.19 years versus 58.86 years for UCH and OSH, respectively. Indications for THR at UCH were aseptic loosening, instability and trunnionosis. Type of revision performed were isolated head/liner (44.12%), femoral component (29.41%), acetabular component (17.65%) and all components (8.82%).

Conclusion

The THR indications were loosening, instability and metal on metal/trunnion. Femoral component and head/liner revisions were performed the most for these patients, which suggest an increased surgical complexity for the referred patient. This study provides insight into the patterns of why referred THR procedures are performed at UCH which can lead to better predictions and planning by the surgeon.

Primary Presenter: Megan Kalata

Project Title: *Community Perspectives on the Racial Disparity in Infant Mortality*

Primary Mentor: Janet Meredith, Department of Family Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

**Background**

The United States' infant mortality rate is significantly higher among infants born to non-Hispanic Black women than infants born to women of other races, independent of educational attainment, marital status, or socioeconomic status. Addressing this disparity requires a multifaceted understanding of contributing factors and dynamics. Thus, we sought to explore community member perspectives on pregnancy, birth, and experiences in healthcare during the perinatal period.

**Method**

Researchers conducted focus groups with African American/Black women in the Denver community who had been pregnant previously and performed inductive thematic analysis looking at the interaction between race, perception of healthcare, and pregnancy/birthing experiences.

**Results**

Six focus groups (n=27) were completed. Participants reported that barriers to quality healthcare and emotional support during the perinatal time frame included being young during the time of pregnancy, having transportation difficulties, limited clinic hours, conflicting family beliefs, and being insured by Medicaid. Additionally, women perceived that healthcare professionals provide substandard care based on implicit bias. Participants felt that they lacked autonomy in decision-making related to their bodies or their babies. They also expressed an underlying mistrust in the healthcare system based on historic maltreatment of African American/Black people by medical institutions. Finally, the women described a need for more providers of color within healthcare systems.

**Conclusions and Relevance**

The African American/Black women in this study perceived discrimination from their healthcare providers based on race, age, and insurance status. They defined additional barriers to support including clinic locations and hours as well as differing family beliefs. To improve the relationships between African American women and their providers, participants expressed that racism and implicit bias must be recognized and addressed. Future directions based on this study include provider education on bias and healthcare disparities as well as community-based initiatives to provide support among African American/Black women during pregnancy and motherhood. It may also include system-level modifications to address bias, increase diversity within the healthcare field, and ultimately decrease the racial disparity in infant mortality.

Primary Presenter: Kathryn Kalata

Project Title: *Community Perspectives on the Racial Disparity in Infant Mortality*

Primary Mentor: Janet Meredith, Family Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

Background

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Primary Presenter: Warren Keyser

Project Title: *Prescription Practices and Risk Factors Associated with Chronic Opioid Use in Opioid Naive Patients: A Review*

Primary Mentor: Joseph Sakai, Psychiatry

Thematic Area: Public Health and Epidemiology

Abstract:

Abstract

Intro: Given the mortality and morbidity associated with chronic opioid use, it is imperative to explore patient risk factors and prescriptions practices associated with chronic use in index prescriptions for opioid naive patients.

Methods

Systematic search of PubMed and PsychINFO using PRISMA guidelines.

Results

623 articles were identified following database search and reference screening of articles. 30 articles underwent full-text screening. 12 articles were included in the review.

Discussion

Patient characteristics associated with long-term opioid use included depression, anxiety, history of substance use, and chronic pain diagnoses at time of index prescription. Cumulative dose, days ' supply and long acting opioids are positively correlated with long-term opioid use.



Primary Presenter: Peter Klauck

Project Title: *Metabolic reprogramming enhances the efficacy of mTOR inhibition in colorectal cancer*

Primary Mentor: Todd Pitts, Medical Oncology

Thematic Area: Basic Biomedical Science

Abstract:

Background

PI3K/mTOR pathway is mutated in 10-20% of colorectal cancer (CRC) specimens and has been associated with poor survival. Phosphatidic acid (PA) is a central lipid membrane metabolite and lipid second messenger which has been shown to target mTOR. It is thought that PA lipid signaling to mTOR in part promotes mTOR mediated cancer cell growth, proliferation and survival. Diacylglycerol kinases (DGKs) are one of several mechanisms of PA generation. In this study, we found diacylglycerol kinases to be synthetically lethal in mTOR inhibitor resistant CRC. We evaluated the anti-proliferative, pharmacodynamic and metabolic effects of dual inhibition with mTOR (TAK-228) and DGK (ritanserin and R59022) inhibitors.

Methods

A synthetic lethal screen was performed with two TAK-228 resistant colorectal cancer cell lines (HCT116 and SW620). Subsequent experiments were performed with one TAK-228 sensitive (DLD1) and one resistant (HCT116) CRC cell lines. Efficacy of TAK-228/ritanserin and TAK-228/R59022 combination therapy was evaluated with CellTiter-Glo cell viability and clonogenic colony formation assays. Global metabolomics profiling of DLD1 and HCT116 cells upon treatment with TAK-228, R59022, and in combination was performed using ultra high pressure liquid chromatography coupled to mass spectrometry. Pharmacologic DGK inhibition was phenocopied using lentiviral shRNA knockdown of DGK $\beta$ . Immunoblotting was performed to evaluate mechanism of action of TAK-228 combination therapy.

Results

TAK-228 combined with ritanserin and R59022 demonstrated decreased cell viability and colony formation as compared to either single agent. Immunoblotting confirmed TAK-228 abrogates PI3K/mTOR pathway activity. DGK inhibition alone resulted in a compensatory activation of mTOR signaling. DGK inhibition disrupted the phosphatidic acid pathway in DLD1 and HCT116 as evidenced by a decrease in PA synthesis and elevation of glycerol 3-phosphate levels, respectively: altering energy metabolism. Specifically, in HCT116, glucose utilization, glutaminolysis, and Krebs cycle anaplerosis were elevated; while one carbon metabolism was decreased. Lentiviral shRNA transduction resulted in DGK $\beta$  knockdown as evaluated by RT-PCR and immunoblot. Phenocopy combination therapy with TAK-228 and DGK $\beta$  knockdown resulted in an increased sensitivity to mTOR inhibition compared to mock transduced control.

Conclusions

Pharmacologic and shRNA knockdown inhibition of DGK in combination with mTOR inhibition resulted in decreased cancer cell viability and decreased colony formation. Pharmacologic inhibition of mTOR and DGK, alone or in combination, alter metabolic wiring in crucial pathways such as energy metabolism, nucleotide biosynthesis, and the generation of lipid precursors. Impaired phosphatidic acid production

may sensitize cells to mTOR inhibition. These results suggest a therapeutic anti-cancer advantage of simultaneously targeting lipid signaling/metabolism via diacylglycerol kinases and mTOR.

Primary Presenter: Jackson Kloor

Project Title: *Postoperative Complications after Tonsillectomy in Treating Sleep Disordered Breathing in Obese and Severely Obese Children.*

Primary Mentor: Norman Friedman, Pediatric Otolaryngology

Thematic Area: Clinical Science

Abstract:

Pediatric obesity is a significant risk factor for the development of sleep-disordered breathing (SDB) and obstructive sleep apnea (OSA) as diagnosed by polysomnography (PSG). SDB/OSA in pediatric patients is commonly treated with tonsillectomy. There is a lack of consensus in current literature concerning the need for inpatient monitoring after tonsillectomy in obese but not severely obese pediatric patients with mild OSA/SDB. The primary objective of this study is to examine the relationship between pre-operative patient variables and post-operative complications in obese and severely obese children to investigate appropriate patient monitoring practices following tonsillectomy. Through retrospective chart review, 224 children between 3-18 years of age with a Body Mass Index Percentile (BMI%) greater than 95th percentile who underwent tonsillectomy between January 2003 and February 2017 for SDB or OSA as diagnosed by PSG, were identified. Demographic and clinical variables, surgical variables, location and length of hospital stay, oxygen usage post-operatively, pre- and post-operative PSG parameters when available, and post-operative complications up to 3 weeks following surgery were recorded. Obesity was grouped into 3 classes, BMI at or less than 120% of the 95th percentile, BMI at or greater than 120% to less than 140% of the 95th percentile, and BMI greater than 140% of the 95th percentile. Logistic regression on demographics, prematurity, asthma, recent upper respiratory infection (URI) and other co-morbidities was performed. There was no significant difference between BMI percentile ( $p$ -value = 0.7312), severity of OSA pre-operatively ( $p$ -value = 0.08241) and severity of OSA post-operatively ( $p$ -value = 0.1305) with post-operative complications following tonsillectomy. In obese pediatric patients, severity of obesity or OSA were not predictors of post-operative complications. These results are equivocal for inpatient monitoring following tonsillectomy though argue patients with severe obesity and/or OSA are at a similar risk of postoperative complications compared to obese patients with moderate to mild OSA. Additional studies are required to further investigate the need for inpatient monitoring following tonsillectomy.

Primary Presenter: Greta Kreider Carlson

Project Title: *Comparison of 24-h Ambulatory Blood Pressure in Non-Hypertensives and Hypertensives at High Altitude: Preliminary Data from the Colorado High Altitude Monitoring Blood Pressure Study (CHAMPS)*

Primary Mentor: Linda Keyes, Emergency Medicine

Thematic Area: Clinical Science

Abstract:

#### Introduction

Hypertension is the most common cardiovascular disease in high altitude travelers; however, little is understood about how high altitude affects ambulatory blood pressure (ABP) in those with hypertension vs. those without. Previous studies have demonstrated high individual variation in blood pressure response, and impaired nocturnal dipping in patients with hypertension at high altitude.

#### Objective

Compare 24h ABP in participants with and without preexisting hypertension at high altitude.

Methods: This was a preliminary prospective observational cohort study of lowlanders during their first 24h at high altitude (2800-3000m) in Colorado. After arrival to high altitude, volunteers wore a Welch-Allyn 6100 ABP monitor that measured blood pressure every 30 minutes while awake and hourly while asleep.

#### Results

We recruited 15 participants, 10 with hypertension, 5 without. 9/10 participants with hypertension were on antihypertensive medication, including ACE-inhibitors, ARBs, beta-blockers, calcium channel blockers, and diuretics. There were 9 males and 6 females, ages 55-77. Mean awake SBP was 168 mmHg in normotensives vs. 150 mmHg in hypertensives (mean diff 18 (95%CI: -5-41),  $p>0.05$ ). Mean nocturnal SBP was not significantly different between groups (132 mmHg vs 123 mmHg, mean diff 9 (CI: -24-42),  $p<0.05$ ). Extreme SBP readings ( $\geq 180$  mmHg) occurred in both groups: 50% (5/10) of participants with HTN vs. 60% (3/5) without. Normal nocturnal blood pressure dipping was impaired in 40% of hypertensives vs. 25% of normotensives ( $p>0.05$ ).

#### Conclusions

Our preliminary data suggest that hypertensive and normotensive travelers have similar average and peak SBP after initial travel to high altitude. Our ongoing and future studies aim to confirm these results with a larger sample size and compare to low altitude measurements to assess whether elevated potential blood pressure changes are related to high altitude or individual physiology

Primary Presenter: Vishnupriya Krishnan

Project Title: *A Cross-Sectional Study of Knowledge, Attitudes, and Practices Surrounding Exclusive-Breastfeeding at Dhulikhel Hospital, Nepal*

Primary Mentor: Jennifer Whitfield, Emergency Medicine

Thematic Area: Global Health

Abstract:

**Background**

Rates of malnutrition and stunting in Nepal are among the highest in the world. Exclusive breastfeeding, defined as giving an infant only breast milk without any food or liquid supplementation, is known to be protective against stunting and is recommended by the World Health Organization (WHO) until an infant is six months of age. Few studies have addressed the lack of exclusive breastfeeding (EBF) as a contributing factor to malnutrition and stunting in Nepal. The objective of this research study was to determine knowledge, attitude and intentions to exclusively breastfeed of pregnant women receiving care at the Antenatal Clinic at Dhulikhel Hospital in the Kavre District of Nepal.

**Methods**

A cross-sectional survey was conducted among 302 pregnant women that attended the antenatal clinic at Dhulikhel Hospital in Nepal from June to August 2015. The quantitative questionnaire was created from a survey used to evaluate barriers to EBF in Zimbabwe, with additional questions based on the Behavioral Theory Model. Data set is categorical and was statistically analyzed using Fisher 's Exact Test.

**Results**

Knowledge of exclusive breastfeeding recommendations, belief of ability to produce sufficient breast milk, and perception of the necessity for infant supplementation influenced mothers ' decision to discontinue exclusive breastfeeding. Most women reported healthcare workers as influential in their decision to breastfeed, whereas local community and familial attitudes had little influence on mothers ' decisions.

**Conclusion**

Lack of knowledge of the definition of exclusive breastfeeding is prevalent among pregnant women receiving care at Dhulikhel Hospital. The belief that infants require supplemental food or formula appears to have a particularly influential impact on cessation of exclusive breastfeeding within the first six months of an infant 's life. Interventions driven by health-care workers have the potential to influence the intentions regarding exclusive breastfeeding in pregnant women in Nepal.

Primary Presenter: Maggie Kuusinen

Project Title: *Aging out – understanding the importance of transitions of care for adolescents and young adults leaving the foster care system*

Primary Mentor: Anne Frank, Internal Medicine/Pediatrics

Thematic Area: Clinical Science

Abstract:

In Colorado there are almost 6,000 children in foster care – 44.5% of which are ≤ 12 years of age (CWO report 2017). Adolescents placed in the foster care system are a vulnerable population where social determinants lead to health disparities that greatly impact their wellbeing. Between the ages of 18 and 21, these young adults age out of the foster care system and must also transition from a pediatric to adult model of health care. In the best of circumstances the transition to adult models of care can pose health risks for young adults, however these risks are likely heightened in a vulnerable population that has recently lost support provided by the government. The objective of this review article is to synthesize literature on foster care legislation, statistics, outcomes, health disparities and adverse childhood experiences combined with literature on transitions of care to explain why a structured transition to adult care models for patients aging out of the foster care system is necessary. We also describe our plans for future quality improvement research at the new foster care transition clinic we developed and implemented at the Denver Health Bernard F. Gibson Eastside Family Health Center, which began seeing patients in October 2019.

Primary Presenter: Steven Lai

Project Title: *Mechanisms of Radiation-Induced Brain Edema Alone and in Combination with T-DM1 in Her2+ Brain Metastases*

Primary Mentor: Diana Cittelly, Pathology

Thematic Area: Basic Biomedical Science

Abstract:

Breast cancer is the most common type of cancer in women [1]. Twenty to thirty percent of breast cancers overexpress human epidermal growth factor receptor 2 (HER2). HER2+ breast tumors are more aggressive, and 40-50% of patients with HER2+ breast cancer develop brain metastases [2, 3]. HER2+ brain metastases are treated with radiation alone or in combination with a humanized antibody against HER2, Herceptin (Trastuzumab), or its derivative T-DM1 (Ado-trastuzumab Emtansine, which carries an additional cytotoxic agent) [4, 5, 6]. T-DM1 has been shown to prolong progression-free survival (6.4 to 9.6 months) and overall survival (25.1 to 30.9 months) in patients previously treated with Herceptin [5, 6]. T-DM1 received FDA approval in 2013 to treat brain metastases in HER2+ patients [5]. However, recent studies have shown an increased rate of cerebral edema in patients whose brain metastases were treated with T-DM1 and radiosurgery, compared to patients who received Herceptin and radiosurgery or radiosurgery alone [7, 8]. Since the severity of the edema prevents patients from continuing treatment, it is critical to determine the mechanisms underlying this T-DM1 and radiosurgery cytotoxicity. Astrocytes are key components of the blood brain barrier, and play a critical role in modulating water flow and the regulation of brain edema [9]. A key protein for this function is the water transporter aquaporin 4 (AQP4), which is expressed in the end-feet of astrocytes [10, 11, 12, 13, 14]. Preliminary data suggests that reactive astrocytes which surround brain metastases express HER2, and are therefore susceptible to Herceptin and T-DM1. Therefore, we hypothesize that T-DM1 in combination with radiation causes astrocytic swelling and brain edema through modulation of AQP4.

Primary Presenter: Eric Lakey

Project Title: *Assessing Elite Athletes using PROMIS Tools: The STEALTH Project (Student Athlete Health Assessment)*

Primary Mentor: Kenneth Hunt, Orthopaedics

Thematic Area: Clinical Science

Abstract:

#### Introduction/Purpose

Injuries are a major part of elite sports and patient-reported outcomes tools (PROs) are becoming commonplace for the assessment of injury and treatment outcomes. The National Institutes of Health (NIH) Patient-Reported Outcomes Measurement Information System (PROMIS) is a validated set of assessment tools with increasing popularity. The PROMIS metrics utilize computerized adaptive testing (CAT) to capture health status measurements through individualized assessments, with minimal user burden, and without the loss of precision or content validity. The purpose of this study was to evaluate elite athletes using PROMIS scores and assess the impact of injury on those scores in order to gain insight into how participation and injury can impact the health of NCAA Division 1 athletes participating in a variety of sports.

#### Methods

Over a six-month period, athletes from 11 sports at a single Division 1 Athletics program were recruited to participate in longitudinal prospective data collection using four PROMIS CAT scales/domains: Pain Interference (PI), Physical Function (PF), Depression, and Ability to Participate in Social Roles and Activities (PSRA). Using REDCap (Research Electronic Data Capture), athletes completed an assessment that included the PROMIS tools prior to participation in their respective sport 's season for the 2018-2019 academic year and following the completion of their season. Athletes suffering a season-ending injury were asked to complete the PROMIS survey within a week following the injury. De-identified data was analyzed using Student 's T-test. PROMIS outcome measures were analyzed using linear mixed model regression. A p-value of < 0.05 was considered statistically significant.

#### Results

A total of 315 pre-season surveys were collected and of those 139 post-season surveys have been completed to date. PF, Depression and PSRA scores were significantly different in athletes than in the general age-matched population. PI scores were similar to the normal population. The distribution of PI and PF scores were significantly different pre and post-season with a difference in means of 2.2 and -3.2 respectively ( $p < .01$ ). No significant difference was observed in the Depression and PSRA scores at the end of the season. A total of 23 significant injuries were reported to date, resulting in a significant change from both pre-season scores and post-season in uninjured controls (Figure 1).

#### Conclusion

We found significantly worse PI and PF scores after a full season compared to preseason, suggesting that athletic participation alone impacts the athlete's overall function and condition. Season-altering injuries resulted in clinically significant differences in all four domains, suggesting that injuries greatly affect athletes not only physically, but mentally and socially. These data indicate that consideration should be given to pre-season PROMIS surveys for individual athletes to ensure that subsequent scores are



properly interpreted. Additional study will elucidate the impact of specific sports and injuries, providing data to physicians, trainers, and coaches to inform treatment and return to sport protocols.

Primary Presenter: Andrew Lamp

Project Title: *A single-site pilot implementation of a novel trauma training program for prehospital providers in a resource-limited setting*

Primary Mentor: Nee-Kofi Mould-Millman, Emergency Medicine

Thematic Area: Global Health

Abstract:

Background

Prehospital (ambulance) care can reduce morbidity and mortality from trauma. Yet, there is a dearth of effective evidence-based interventions and implementation strategies. Emergency Medical Services Traumatic Shock Care (EMS-TruShoC) is a novel bundle of five core evidence-based trauma care interventions. High-Efficiency EMS Training (HEET) is an innovative training and sensitization program conducted during clinical shifts in ambulances. We assess the feasibility of implementing EMS-TruShoC using the HEET strategy, and feasibility of assessing implementation and clinical outcomes. Findings will inform a main trial.

Methods

We conducted a single-site, prospective cohort, multi-methods pilot implementation study in Western Cape EMS system of South Africa. Of the 120 providers at the study site, 12 were trainers and the remaining were eligible learners. Feasibility of implementation was guided by the RE-AIM (reach, effectiveness, adoption, implementation, and maintenance) framework. Feasibility of assessing clinical outcomes was assessed using shock indices and clinical quality of care scores, collected via abstraction of patients' prehospital trauma charts. Thresholds for progression to a main trial were developed a priori.

Results

The average of all implementation indices was 83% (standard deviation = 10.3). Reach of the HEET program was high, with 84% learners completing at least 75% of training modules. Comparing the proportion of learners attaining perfect scores in post- versus pre-implementation assessments, there was an 8-fold (52% vs. 6%) improvement in knowledge, 3-fold (39% vs. 12%) improvement in skills, and 2-fold (42% vs. 21%) increase in self-efficacy. Clinical outcomes data were successfully calculated €there were clinically significant improvements in shock indices and quality of prehospital trauma care in the post- versus pre-implementation phases. Adoption of HEET was good, evidenced by 83% of facilitator participation in trainings, and 100% of surveyed stakeholders indicating good programmatic fit for their organization. Stakeholders responded that HEET was a sustainable educational solution that aligned well with their organization. Implementation fidelity was very high; 90% of the HEET intervention and 77% of the implementation strategy were delivered as originally planned. Participants provided very positive feedback, and explained that on-the-job timing enhanced their participation. Maintenance was not relevant to assess in this pilot study.

Conclusions

We successfully implemented the EMS-TruShoC educational intervention using the HEET training strategy in a single-site pilot study conducted in a low-resource international setting. All clinical

outcomes were successfully calculated. Overall, this pilot study suggests high feasibility of our future, planned experimental trial.

Primary Presenter: Renzo Laynes

Project Title: *Minimally Invasive Proximal Screw Stabilization in Long Posterior Instrumented Spinal Fusion for Prevention of Proximal Junctional Kyphosis and Failure*

Primary Mentor: David Ou-Yang, University of Colorado Hospital Department of Orthopedic Spine Surgery

Secondary Mentor(s): Dr. Vikas Patel

Thematic Area: Clinical Science

Abstract:

The advent of minimally invasive spine surgery techniques (MIS) has allowed surgeons to insert pedicle screws with great accuracy whilst minimizing soft tissue disruption, and this preservation of the posterior soft tissue structures may contribute to the prevention of proximal junctional kyphosis (PJK) and failure (PJF). A retrospective, single-institution, matched cohort study was performed studying the cumulative incidence of PJK and PJF in subjects who underwent minimally invasive proximal screw stabilization (MIS group; N=17) versus those who underwent the standard open proximal screw stabilization (control group; N=24) over 2 years in the setting of posterior spinal fusion surgery involving at least 8 levels. The cumulative incidence of PJK after 2 years was 17.7% in the MIS group compared to 45.8% in the standard technique group (OR = .25 [.06;1.12]; p-value = 0.1). Development of PJF did not vary between the two groups (MIS vs. SA; 0% vs. 12.5%, p-value = 0.25). Regression analysis showed that the Sagittal Cobb Angle (SCA) at the upper instrumented vertebrae (UIV) increased on average 2.2 degrees/month during 2-years of post-operative observation, which was significantly greater than in the MIS group (1.3 degrees/month; p-value = 0.003). At the end of 2 years, the average SCA had increased more in the control group compared to the MIS group (3.3 vs. 10.1 degrees; p-value = 0.015). In patients who undergo posterior spinal fusion surgery involving at least 8 levels, the development of PJK and PJF does not change with a minimally invasive technique compared to the standard open approach. The SCA in patients with an open approach increases more rapidly compared to those receiving a minimally invasive surgery over 2 years. This study is limited by small sample size and larger, multicenter studies should be done to confirm these findings.

Primary Presenter: Eric Lemieux

Project Title: *Recorded Characteristics of Adults with Autism in the University of Colorado Health System*

Primary Mentor: Peter Pressman, Neurology

Thematic Area: Public Health and Epidemiology

Abstract:

**Objective**

To describe demographic and medical information regarding adults with autism in the University of Colorado Health System over one year's time.

**Participants and Methods:** We used EPIC's Slicer/Dicer tool to review de-identified medical records of 4,937,894 patients, all over the age of 21 between January 1 and December 31, 2018, and then queried SNOMED for Autistic Disorder and ICD-10 codes 84.0, 84.5, and 84.2. We then collected demographic information including sex, race, ethnicity, and age, social data including marital status and health habits, prevalence of psychiatric and neurological comorbidities, and use of psychiatric and neurologic medications. We compared these measures to those cited in published research as well as the general population.

**Results**

The overall reported prevalence of autism spectrum disorders (ASD) among patients in the University of Colorado Health Care System was 0.05%, considerably lower than the 1% to 2.5% population prevalence reported in current research. Of those adults reported with ASD, approximately 2.5% were female, lower than prior reports of a 4:1 male-female ratio. 8% were Hispanic (state population percentage 20%). 83% identified as Caucasian. Of those adults with a recorded ASD diagnosis, 79% were age 40 or younger. Depression was included in the medical history in 35% and anxiety in 34% of ASD adults. 16.8% were diagnosed with schizophrenia or bipolar disorder. 23% had a diagnosis of seizure or epilepsy, and 86% had some form of insomnia. About 5% were on an antipsychotic medication, 44% were on an antidepressant, and 34% were on an anxiolytic. 10% were on a CNS stimulating agent, and 36% were prescribed an antiepileptic medication.

**Conclusions**

These numbers suggest that at least 95% of appropriate ASD diagnoses may not be included in medical records of adults with ASD. Such a lack of recorded ASD diagnosis may be especially pronounced in women, older individuals, and Hispanic/Latino populations. The rates of medical comorbidities suggest that this complex population would be well served by providers' recognition of ASD and associated learning needs when providing medical care and treatment.

Primary Presenter: Pierce Lewien

Project Title: *Investigation of Nicotinamide Riboside Use in Diabetic Mice in the Prevention of Kidney Disease*

Primary Mentor: Moshe Levi, Biochemistry Department

Thematic Area: Basic Biomedical Science

Abstract:

**Purpose of Study**

Diabetes is a main cause for chronic kidney disease and end stage kidney disease leading to many deaths and disabilities in the United States and abroad. Despite interventions that have some clinical benefit such as tight glucose and blood pressure control, kidney disease continues to be a problem in many of these patients. Promising research recently though has shown that mitochondrial dysfunction plays an important role in the pathogenesis of kidney disease. One protein that plays a vital role in regulation of mitochondrial function, Sirtuin 3 (SIRT3), could be one such target for therapy in patients with chronic kidney disease.

**Methods Used**

We used kidney biopsies from human patients with and without diabetic nephropathy or glomerulopathy to measure for SIRT3 expression and activity. To measure for prevention of diabetic kidney disease, we conducted a study comparing three groups of mice: A control group, a diabetic group, and a diabetic group treated with a precursor for NAD<sup>+</sup> and modulator of SIRT3, nicotinamide riboside (NR). We performed histology staining to assess the kidney pathology. We also measured for urine albumin and tubular injury marker KIM-1 level. To explore the mechanism for the effects of NAD<sup>+</sup> supplementation, we measured the SOD2 acetylation to reflect the SIRT3 activity and further looked at the mitochondrial biogenesis, mitochondrial function and oxidative stress.

**Summary of Results**

SIRT3 expression and activity decreased in human glomeruli and tubules in diabetic patients compared to controls. This result was also shown in diabetic mice compared to controls. Treatment with NR in diabetic mice decreased mesangial expansion, glomeruli area, albuminuria, and urine KIM-1 level. These changes were associated with the decreased acetylation for SOD2 and total protein lysine acetylation, suggesting an increased SIRT3 activity with the treatment, which led to the increased mitochondrial biogenesis and activity, increase in respiratory chain complexes, and reduced oxidative stress level, compared to control.

**Conclusions**

SIRT3 plays an important role in the progression of diabetic kidney disease. As shown in the human kidney biopsies, SIRT3 expression and activity decreased in diabetic patients compared to the controls. This same scenario happened in mice as well. Furthermore, markers of kidney disease decreased in treated diabetic mice compared to the untreated diabetic mice. The results of this study show promising results about a potential pharmaceutical target to help prevent the progression of diabetic kidney disease.

Primary Presenter: Tamara Lungay

Project Title: *Evaluating Outcomes of a Three-Tiered Orientation System in Matching Surgical Technicians to Cases Based on Skill*

Primary Mentor: Shandra Wilson, Urology

Thematic Area: Clinical Science

Abstract:

New surgical technicians at University of Colorado Hospital (UCH) could be assigned high-risk, complex cases. This could negatively impact learning, patient outcomes, and expenses. We created a novel, tiered orientation system to pair technicians to surgical cases based on skill level, and evaluated outcomes with surveys and medical error data review. April 2015 - September 2016, we implemented the tiered orientation system for surgical technicians at UCH, a high-volume, academic surgical center. Trainees, surgeons, and operating room leadership completed pre- and post-surveys evaluating the program. Survey questions asked about case-assignment efficacy and perceived patient risk. We used T-tests to assess changes, and obtained data on retained surgical items (RSI) and incorrect counts (discrepancies in surgical equipment counts before versus after surgery) from hospital records. Pre- and post-surveys were completed by 27/47 and 6/13 trainees, respectively, 16/38 and 16/38 surgeons, and 5/16 and 7/15 OR leaders. Leaders reported significant positive changes for the following survey items: awareness of objective criteria ( $p=.008$ ); ease of case-matching ( $p=.02$ ); objectivity of assignments ( $p=.03$ ); and assignment appropriateness ( $p=.006$ ). Additionally, RSI and incorrect counts declined during this program. This study suggests that a skill-based case-matching system has potential to improve assignments and objectivity. Decreased incorrect counts and RSI suggest improved patient outcomes. Survey responses from leadership demonstrate perceived improvement, which could be attributed to leadership's observant nature, while surgeons/trainees may encounter issues first-hand. Further research with a larger sample size is necessary to confirm findings

Primary Presenter: Angel Li

Project Title: *Continuous glucose monitoring in youth with cystic fibrosis treated with lumacaftor-ivacaftor*

Primary Mentor: Christine Chan, Pediatric Endocrinology

Thematic Area: Clinical Science

Abstract:

#### Background

The effects of lumacaftor-ivacaftor therapy on glycemia have not been thoroughly investigated. Continuous glucose monitoring (CGM) provides detailed information about glycemic patterns and detects glucose abnormalities earlier than traditional screening tools for diabetes.

#### Methods

CGM measures, HbA1c, and oral glucose tolerance test (OGTT) results were collected and within-subject results compared in F508del homozygous youth with CF before and after initiation of lumacaftor-ivacaftor using the Wilcoxon signed-rank test.

#### Results

Nine youth with CF (6 males, median age 12.7 years) were enrolled. CGM was performed in all participants before (median 26 weeks) and after lumacaftor-ivacaftor (median 29 weeks). HbA1c and fasting plasma glucose increased ( $p=0.02$ ) after lumacaftor-ivacaftor initiation. No changes in OGTT 1 hour or 2 hour glucose nor CGM measures were observed overall. When analyzed by sex, males showed lower glycemic variability, as reflected by the mean amplitude of glycemic excursions, on the post-treatment CGM.

#### Conclusions

Glycemic abnormalities persisted in CF patients treated with lumacaftor-ivacaftor, although sex-dependent differences in glycemic response to treatment may exist.



Primary Presenter: Matthew Lippi

Project Title: *Resolution of Ring Tourniquet with a High-speed Dental Drill in a Remote Pacific Island Clinic.*

Primary Mentor: Leana May, Pediatric Emergency Medicine

Thematic Area: Clinical Science

Abstract:

Ring tourniquet syndrome is a strangulation injury, usually at the proximal finger or toe, caused by a rigid circular metal object. The resulting ischemia can lead to necrosis, permanent nerve and/or tissue damage, and amputation of the digit. There are numerous non-cutting methods for removing the ring; however, edema, fractures, or arthritis near the site can occasionally make these techniques difficult or impossible. While ring cutters, manual or electric, are the first choice for resolving ring tourniquet caused by metal jewelry, these tools are not readily available everywhere. Resolution of ring tourniquet with high-speed rotary tools has been previously described as a tertiary method. Here we describe the use of a high-speed dental tool as a primary ring cutting method for the resolution of ring tourniquet in a patient with significant edema in a low-resource setting.

Primary Presenter: Tim Liu

Project Title: *Using 4D MRI to Analyze Flow Alterations Across a Stent in an In-Vitro Model*

Primary Mentor: Gareth Morgan, Pediatric Cardiology

Thematic Area: Basic Biomedical Science

Abstract:

Analyzing blood flow using non-invasive measures is becoming more important to understanding certain disease states and cardiovascular function. Current methods of imaging and assessing cardiac function have limitations; however, there are promising new uses for 4D MRI as a way of accurately measuring flow and other parameters. Our project looks at flow alterations across a stent in an in vitro setting. We hypothesize that the total flow upstream and downstream of a stent will be the same; however, the shape of the velocity profiles may be changed. A Numed Cheatham Platinum stent was placed in a section of tubing connected to a pulsatile flow generator. 4D MRI images were taken and measurements were obtained at locations upstream, downstream, and at the stent. When comparing the flow upstream of the stent and downstream of the stent, there were no statistically significant changes. However, the shape of the velocity profiles was different between upstream and downstream. Our results demonstrate that flow can be captured accurately using 4D MRI at obstructed locations of tubing, and that total flow is maintained while velocity profiles change in an in vitro model.

Primary Presenter: Colleen Long

Project Title: *Pediatric Obesity and Exposure to Environmental Adversity*

Primary Mentor: Ayelet Talmi, Psychology

Thematic Area: Clinical Science

Abstract:

**Background**

Exposure to 4 or more environmental adversity factors in childhood is associated with a 1.4-1.6 fold increase in obesity and myocardial infarction in adulthood and a 1.4 increase in coronary artery disease and stroke. Specifically, experiencing sexual abuse in childhood is associated with an elevated risk of being obese in adulthood. However, few studies have investigated adversity exposure and elevated weight in childhood. The aim of this study is to characterize the relationship between environmental adversity, pediatric obesity, and cardiovascular risk factor diagnoses.

**Methods**

A retrospective medical review of electronic medical records of 295 children aged 1 to 17 years old with elevated BMI was conducted. Records were obtained from Child Health Clinic at Children's Hospital Colorado, selecting for patients who received a mental health consultation following a weight measurement of BMI greater than the 85th percentile. Data collected included: demographics, cardiovascular risk related diagnosis, BMI and behavioral health flowsheets. Following EHR abstraction encounter data were manually coded for adversity using ATLAS.ti.

**Results**

The sample was predominately Latino/Hispanic (67.7%) and publicly insured (85.7%) patients. There were equal percentages of males and females (50.5% and 49.5%, respectively). On average, there were 1.5 adversity factors reported per child with 72.5% of patients reporting at least one adverse experience. The most common adversity factor reported was family separation (38%) followed by abuse (15%). Weight diagnoses were evenly distributed between overweight (25.8%), obese (40.3%), and morbidly obese (33.9%). There were 38 patients with cardiovascular risk factor diagnoses including: essential hypertension, hyperglycemia, hypertriglyceridemia, and dyslipidemia. After correcting for age, race, gender, insurance, and financial factors families who reported housing instability were more likely ( $p=0.002$ ) to have children who were morbidly obese (61.3%) than families who did not report housing instability (30.7%).

**Conclusion**

This study demonstrated a high percentage of Latino/Hispanic and publically insured children had elevated BMI relative to the given patient population. Additionally, the most common environmental adversity factor in the overweight or obese pediatric population was family separation. Finally, it demonstrated a dose dependent relationship between elevated weight in childhood and housing instability.

Primary Presenter: Bailey Loving

Project Title: *Lipid and Lipoprotein Metabolism in Microglia*

Primary Mentor: Kimberley Bruce, Department of Endocrinology, Metabolism and Diabetes

Secondary Mentor(s): Robert Eckel, MD, Department of Endocrinology, Metabolism and Diabetes

Thematic Area: Basic Biomedical Science

Abstract:

Microglia, once viewed as static bystanders with limited homeostatic functions, are now considered key players in the development of neuroinflammatory and neurodegenerative diseases. Microglial activation is a salient feature of neuroinflammation involving a dynamic process that generates multitudinous microglial phenotypes that can respond to a variety of situational cues in the central nervous system. Recently, a flurry of single cell RNA-sequencing studies have defined microglial phenotypes in unprecedented detail, and have highlighted robust changes in the expression of genes involved in lipid and lipoprotein metabolism. Increased expression of genes such as Apolipoprotein E (ApoE), Triggering Receptor Expressed on Myeloid Cells 2 (TREM2) and Lipoprotein Lipase (LPL) in microglia during development, damage, and disease, suggest that increased lipid metabolism is needed to fuel protective cellular functions such as phagocytosis. This review describes our current understanding of lipid and lipoprotein metabolism in microglia, and highlights microglial lipid metabolism as a modifiable target for the treatment of neurodegenerative diseases such as Alzheimer 's disease and multiple sclerosis.

Primary Presenter: Zachary Lubline

Project Title: *Healthcare 101: Standardizing Healthcare Orientation for Incoming Refugees in America*

Primary Mentor: Jeremy Long, Internal Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

Refugees face unique challenges in the countries that they are relocated into. In the U.S., utilizing the complex healthcare system is one of the greatest difficulties that refugees must tackle. Here, we outline the current state of the refugee crisis and the current need for a better standardized refugee orientation to U.S. healthcare. We introduce a draft presentation which was created to be utilized by Denver refugee organizations as an introduction for incoming refugees, with the goal of increasing health literacy and comfort interacting with the U.S. healthcare system. We discuss specific limitations to this sort of presentation and goals for further implementation on a statewide and national scale.

Primary Presenter: Armela Makas

Project Title: *Investigating the Mechanism Behind a Lupus-Protective Single Nucleotide Polymorphism in the Complement Receptor 2 Gene*

Primary Mentor: Susan Boackle, Rheumatology

Thematic Area: Basic Biomedical Science

Abstract:

In recent years, researchers (Zhao, et al.) have uncovered a single nucleotide polymorphism (SNP) in an intronic region of the human complement receptor 2 (CR2) gene which may confer protection from developing systemic lupus erythematosus (SLE), as this SNP is significantly more common in healthy individuals as compared to those with SLE. The exact mechanism of this protection is unknown; however, these researchers have also uncovered a long non-coding RNA (lncRNA), called lnc9124, transcribed from exon 1 and exon 2 of the CR2 gene that is more highly expressed in those who possess the SNP, indicating that this lncRNA may mediate the protective effect. Furthermore, RNA sequencing data revealed a difference in mTOR expression between healthy individuals who possess the SNP and those who do not. The aims of this study are the following: first, confirm that mTOR expression is different between the SNP positive and SNP negative groups; second, determine if there is any correlation in the expression of mTOR, the lnc9124, CR1, and CR2 genes. These two aims have been addressed with a correlation experiment. The experiment looked at the transcript expression of CR1, CR2, lnc9124, and mTOR in six SNP positive healthy individuals and six SNP negative healthy individuals. cDNA was prepared from RNA samples from the twelve subjects, and expression levels were assessed by qRT-PCR. Data was analyzed via the delta Ct method, and the groups were compared using an unpaired t-test assuming unequal variance with an alpha level of 0.05 as significance cut off; this was done in the Prism statistics program. Results demonstrated CR1 to be more highly expressed in the SNP positive group ( $p=0.025$ ), mTOR more highly expressed in the SNP positive group ( $p=0.041$ ), with no significant difference in lnc9124 expression or CR2 expression between the two groups. Also, CR1 expression was positively correlated with mTOR expression (pearson  $r=0.91$ ,  $p<0.0001$ ). In the future, it will be important to perform knock down experiments of the lncRNA and mTOR in human B cells of healthy SNP positive and SNP negative individuals in order to further investigate the exact mechanism of this SNP and to determine how mTOR and CR1 expression are related.

Primary Presenter: Daniele Marcy

Project Title: *An Investigation into the Usage of Bisphosphonate Therapy in Patients with Osteogenesis Imperfecta*

Primary Mentor: Ellen Elias, Pediatrics

Thematic Area: Clinical Science

Abstract:

#### Background

Osteogenesis imperfecta (OI) is the most prevalent heritable bone fragility disorder in children [11]. Children with COL1a1 haploinsufficiency mutations have an almost 100-fold increased rate of femur and tibia fractures [11]. To improve their quality of life and reduce fracture rates by increasing bone mineral density, patients with increased severity as determined by clinical history (not by type of OI) are frequently treated with bisphosphonates [12]. Patients with Osteogenesis Imperfecta frequently are diagnosed with nephrocalcinosis or nephrolithiasis as a result of their disease process. As the collagen in their bones is formed abnormally and hence unstable, bone mineralization is impaired leading to increased levels of serum calcium secondary to degeneration and increased bony turnover leading to its deposition in other areas of the body, including the kidneys. The body's normal homeostatic mechanism for serum calcium regulation involves the function of osteoclasts that work to release stored calcium from bone as needed to maintain serum calcium levels within normal limits. In patients with OI, the unstable bony matrix is degraded more frequently by osteoclasts resulting in increased serum calcium levels to be filtered by the kidneys. Bisphosphonates function through intervening in this cycle by decreasing production of osteoclast progenitor cells, promoting osteoclast apoptosis, and impairing the normal bone resorption mechanism [21]. There is a paucity of data regarding the natural history of these kidney pathologies and their relationship with treatment with bisphosphonate therapy and some investigators question whether bisphosphonate therapy results in development of these pathologies. We hypothesized that treatment with bisphosphonates in patients with Osteogenesis Imperfecta (OI) will not result in the development of nephrocalcinosis or nephrolithiasis as bisphosphonates work to decrease serum calcium through downregulation of osteoclasts, which would lead to decreased filtration of serum calcium by the kidneys. Our specific aims included: [1] To examine the effects of bisphosphonates on kidneys of patients with OI, and how this differs between different types of OI and [2] To assess the safety and tolerability of bisphosphonates, specifically in relation to the development of nephrocalcinosis and nephrolithiasis in patients with OI.

#### Methods

A retrospective chart review of patients from the Children's Hospital of Colorado (CHCO) Osteogenesis Imperfecta population was performed. No statistical data analysis was performed. Patients who were selected have been seen in the Osteogenesis Imperfecta Multidisciplinary Clinic at CHCO and were followed by Dr. Ellen Roy Elias with serial renal ultrasound (US) and calcium to creatinine ratios (Ca:Cr).

#### Results

8 patients out of the 50 who were included in the study were found to have received the diagnosis of nephrocalcinosis and/or nephrolithiasis after being diagnosed with Osteogenesis Imperfecta. Out of the 50 patients in the target population, 33 of these patients were treated with bisphosphonate therapy. Of the 8 patients who developed either nephrocalcinosis or nephrolithiasis, 3 have had continued evidence

of nephrocalcinosis and/or nephrolithiasis on serial renal ultrasounds over the course of treatment with bisphosphonate therapy. Of those 3 patients, all have been treated on the new pamidronate protocol. Of the patients who developed either nephrocalcinosis and/or nephrolithiasis, 7/8 patients were diagnosed with a more severe phenotype of OI based on genetic analysis by either DNA sequencing or collagen analysis.

#### Conclusions

Treatment with bisphosphonate therapy does not appear to directly result in the development of nephrocalcinosis and/or nephrolithiasis. Treatment with higher dosing of bisphosphonates over a shorter interval may lead to increased frequency of development of nephrocalcinosis and/or nephrolithiasis in patients with osteogenesis imperfecta.



Primary Presenter: Alejandro Itzam Marin

Project Title: *A Third-year Ophthalmology Experience for the Denver Health Longitudinal Integrated Clerkship.*

Primary Mentor: Jasleen Singh, Ophthalmology

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Introduction

Despite eye conditions being ubiquitous in primary, urgent, and emergency care, ophthalmologic education continues to decrease in medical school<sup>1-3</sup>. A basic knowledge of ophthalmology with the ability to recognize and refer common eye diseases and emergencies is essential for medical education. We performed a needs assessment of CUSOM third-year medical students in the Denver Health Longitudinal Integrated Clerkship (DH-LIC). Based on these results, an ophthalmology curriculum was developed incorporating both classroom and experiential components. We hypothesize that this experience will increase ophthalmologic knowledge and confidence in assessing and managing eye complaints among students.

Curriculum goals:

- Identify common eye conditions and treat or triage these disorders
- Increase comfort performing a basic eye exam
- Expose students to ophthalmology
- Identify cohort patients to be followed in other clinics consistent with the curricular goals of the DH-LIC
- Experience subspecialty care for the underserved

Methods

We developed a two-part curriculum: a 2-hour didactic and a clinical experience where students rotate in the eye clinic. During the rotation, students will structure learning with a requirement sheet (Figure 1). To identify the impact of the course, pre-course baseline data was collected from the DH-LIC cohort from academic year (AY) 2018/2019. Post-course data will be collected from students in AY2019 after completion of the curriculum. The survey consists of Likert-scale and confidence questions related to attitudes and knowledge (Figure 2). The results of the survey from both groups will be compared and analyzed (at symposium).

Results

Data collected from AY2019/2018 allows assessment of curricular gaps present before the novel ophthalmology curriculum. Results demonstrated that 94% students recognized as important, regardless of their specialty of choice, to be able to properly identify and refer patients to ophthalmology (Figure 3). None of the students felt completely confident diagnosing and treating common ophthalmic emergencies (Figure 4)

Discussion

It is essential for future providers, regardless of their specialty, to recognize common eye diseases and ocular emergencies. We describe a novel multi-modal approach to clinical education and anticipate this

curriculum will increase the ability of students to recognize, treat, and refer common ophthalmic conditions and emergencies.

Primary Presenter: Andrew Maroncelli

Project Title: *Decreasing Operating Room Turnover Times between Neurosurgical Spine Cases*

Primary Mentor: Claudia Clavijo, Anesthesiology

Thematic Area: Clinical Science

Abstract:

Summary Background Data

The efficiency of hospital operating rooms remains an important topic, especially given the financial impact of surgical procedures. Many factors affect the efficiency of a patient's perioperative course, including those that are intraoperative (surgical procedure, preparation, draping, etc.) and those that are non-operative (anesthesia-associated tasks, patient transport, and operating room turnover). There have been a multitude of studies looking at process improvement methodologies and their effect on operating room efficiency.

Objective

Because of the length and involvement of neurosurgical spine cases, turnover times between cases can be lengthy and multiple steps are required to adhere to facility and state regulations. This study attempts to identify factors affecting operating room turnover times between neurosurgical spine cases from an anesthesia perspective, with the idea of implementing improvements based on our findings to improve patient care and patient safety. Our hypothesis was that increased turnover times would be primarily due to lengthy operating room instrumentation setup and prolonged operating room cleanup times.

Methods

Data were obtained by manually recording times between different stages of operating room turnover between neurosurgical spinal cases from May 18, 2019 to June 1, 2019 at the University of Colorado Hospital Anschutz Medical Campus. These data were then analyzed to determine potential areas of improvement to expedite operating room turnover times.

Results:

The analysis included 19 operating room turnovers between neurosurgical spine cases. Of these turnovers, 73.6% were over 30 minutes, and these increased times were primarily attributed to extra time needed for nursing room and instrumentation set up. Only one turnover was attributed to anesthesia wait times and set up, and this turnover took 45 minutes.

Conclusion

This study found that extra time needed for room and instrumentation set up was a significant factor in extending turnover times between neurosurgical spine cases. Additionally, for operating room turnovers to be compliant with hospital-mandated and Joint Commission regulations, neurosurgical spine cases may need upwards of 45 minutes of allocated turnover time between cases in the hospital OR schedule.

Primary Presenter: Ethan Maulsby

Project Title: *The Role of a One Health Interdisciplinary Curriculum Between Medical and Veterinary Students*

Primary Mentor: Roberto Silva, Family medicine

Secondary Mentor(s): Dr. Mark Deutchman

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Animals and humans share susceptibility to numerous diseases, allowing for animals to serve as a warning sign of potential human illness. The term 'One Health' comes from the idea that the health of animals and humans are essentially 'one' and that there should never have been a separation between the two. Nowadays, the goal of One Health is to encourage collaborative interdisciplinary efforts to achieve the best health outcome for humans, animals, and the environment. Our goals in this project, through the collaborative efforts between students of the University of Colorado School of Medicine (CUSOM) and the University of Colorado Physician Assistant Program (UCPAP) with Colorado State University College of Doctor of Veterinary Medicine students (CSUDVM), is to provide a more meaningful educational experience for students and patients than intra-professional education alone by identifying the connections between human and animal health. Our methods include organizing conferences for medical and veterinary students, hosting events for joint learning, and evaluating the benefits of a One Health model of interprofessional education as reported by the students themselves to improve the rural track curriculum.

Primary Presenter: Aaron Mauner

Project Title: *Morphometric and Cytologic Characterization of Tertiary Lymphoid Follicles in resected bowel of patients with Diverticulitis, Ulcerative Colitis, and Crohne's Disease*

Primary Mentor: Eoin McNamee, Anesthesia

Thematic Area: Basic Biomedical Science

Abstract:

The presentation of ectopic Tertiary lymphoid structures (TLS) in peripheral tissues is a pathological hallmark for a number of Autoimmune and Immune mediated conditions, not least within the bowel wall of patients with Crohn 's disease. However, there remains limited understanding of the cellular constituents or the function of TLS during intestinal pathology. To address this, we characterized the location, size, frequency and cellular constituents of B-cell follicles within resected bowel tissues from patients with Diverticulitis (DIV), Crohn 's Disease (CD) or Ulcerative Colitis (UC) (n=9-10/group). Samples were formalin fixed, paraffin embedded, serially sectioned, and subsequently stained by multiplexed immunohistochemistry. Morphometric analysis was performed with Olympus CellSens software and PerkinElmer Vectra 3.0 Automated Quantitative Pathology Imaging System and statistical analyses performed using R Statistical Software. Results show that the number, size and anatomic location of large B-cell aggregates differed greatly between disease states, with both UC and DIV follicles localizing primarily in the mucosa; while samples from patients with CD presented with mature Ki67+ TLS in the deeper layers of serosa and muscle. Multicolor IHC shows that TLS in Crohn's disease have large intra-germinal center CD4+ T-cell populations while UC samples contained a marked increase in both monocytes and neutrophils compared with both CD and DIV. These data suggest that despite ectopic TLS being present in a number of pathologic conditions, their composition within the bowel wall is disease state dependent and suggests altered germinal center function.

Primary Presenter: Halea Meese

Project Title: *The Accuracy of Prehospital Identification of Stroke in a Large Stroke Belt Municipality.*

Primary Mentor: Nee-Kofi Mould-Millman, Emergency Medicine

Thematic Area: Clinical Science

Abstract:

**OBJECTIVE**

Strokes are a leading cause of morbidity and mortality in the United States, especially in the "stroke belt" of the southeast. Up to 65% of stroke patients access care by calling 9-1-1. The primary objective of this study is to measure the accuracy of emergency medical dispatchers (EMD) and paramedics, in the prehospital identification of stroke.

**METHODS**

The study was based at Grady Emergency Medical Services, which is Atlanta, Georgia's public emergency medical services (EMS) provider. A retrospective analysis of all medically related 9-1-1 calls to Grady EMS classified as "stroke" between January 1, 2012, and December 31, 2012 was performed. A database was created using deterministic linkage between records from Grady EMS, Grady Hospital Emergency Department (ED), and the Grady Hospital Stroke Registry. Patients excluded were less than 18 years of age, had previous or concurrent head injuries, were transferred from another inpatient facility, and/or had incomplete patient records in any one of the three databases. Descriptive analysis, linear regression, and logistic multivariable regression were performed to discover the accuracy of stroke identification and contributory prehospital factors.

**RESULTS**

A total of 548 patients were included: 475 were transported with EMS impression of stroke and 73 with an impression other than stroke. The median age was 59 years, 87.4% were black, and 52.6% were female. Paramedics adhered to all seven elements of the Grady EMS stroke protocol in 76.4% (n = 363) of suspected stroke cases. Sensitivity and positive predictive value for paramedic stroke identification was 76.2% and 49.3%, respectively, and for EMD, was 48.9% and 24%, respectively. Identification of hemorrhagic strokes had a relatively lower sensitivity. Paramedics were more likely to positively identify strokes when the Cincinnati Prehospital Stroke Scale (CPSS) screen was positive, or when classified by EMD as stroke. Paramedics were less likely to identify stroke in female patients. Paramedics' diagnostic accuracy was similar regardless of their adherence to the EMS stroke care protocol.

**CONCLUSIONS**

EMD and EMS personnel in a large city in the Southeastern United States, with high stroke prevalence, had a relatively high sensitivity in identifying acute stroke patients. Paramedic accuracy was augmented by positive CPSS screening and by EMD recognition of stroke.

Primary Presenter: Robert Meller

Project Title: *Descriptive Analysis of Patients with Left Ventricular Assist Devices Undergoing Image-Guided Procedures*

Primary Mentor: Paul Rochon, Radiology

Secondary Mentor(s): Brian Branchford

Thematic Area: Clinical Science

Abstract:

**Purpose**

Left ventricular assist devices (LVAD) are mechanical therapies for end-stage heart failure that require anticoagulation and are associated with high rates of complications including third spacing, bleeding, and thromboembolic events. Minimally invasive image-guided procedures can be invaluable in managing LVAD patients who are not typically considered surgical candidates. This study describes our institution's procedural experience with LVAD patients in interventional radiology (IR).

**Materials**

We reviewed a retrospective database of LVAD procedures performed in an academic medical center from 2010-2018. Demographics, pre-procedural labs, complications, and outcomes data were collected from electronic health records. Descriptive statistics were calculated on both a patient- and encounter-level as many patients in the dataset underwent multiple image-guided procedures. Categorical variables are presented as frequencies with percentages.

**Results**

67 LVAD patients underwent 109 image-guided procedures during the study period. Based on SIR guidelines, 65 (59.6%) procedures were category 2 bleeding risk and 44 (40.4%) were category 1. The most common procedures performed were chest tube placement (n=43, 39.4%), thoracentesis (n=12, 11%), and embolization (n=12, 11%). Patients were therapeutically anticoagulated (pre-procedural aPTT>70 and/or INR>2) for 67 (61.5%) procedures. Intraprocedural blood loss of >50 mL occurred in 2 (1.8%) cases. Post-procedural bleeding occurred in 15 (13.8%) cases, and 38 (34.9%) cases received transfusions within 30 days. Of 12 (11.0%) total complications, 3 patients had major complications requiring further intervention or contributed to clinical deterioration. Eight (11.9%) patients died within 30 days of a procedure; causes of death were determined to be unrelated to the procedure itself or were multifactorial in etiology.

**Conclusions**

While performing image-guided minimally invasive procedures on the LVAD patient population is not without risk, they are sometimes necessary and can be performed if benefits are deemed to outweigh risks.

Primary Presenter: Iain Miller

Project Title: *Ki67 is a Graded Rather than a Binary Marker of Proliferation versus Quiescence*

Primary Mentor: Sabrina Spencer, Department of Biochemistry at CU Boulder

Secondary Mentor(s): Dr. Ana Gleisner, Surgical Oncologist at UCHealth, and Dr. Tony Neto, Pathologist at UCHealth

Thematic Area: Basic Biomedical Science

Abstract:

Ki67 staining is widely used as a proliferation indicator in the clinic, despite poor understanding of this protein's function or dynamics. Here, we track Ki67 levels under endogenous control in single cells over time and find that Ki67 accumulation occurs only during S, G2, and M phases. Ki67 is degraded continuously in G1 and G0 phases, regardless of the cause of entry into G0/quiescence. Consequently, the level of Ki67 during G0 and G1 in individual cells is highly heterogeneous and depends on how long an individual cell has spent in G0. Thus, Ki67 is a graded rather than a binary marker both for cell-cycle progression and time since entry into quiescence.



Primary Presenter: Madison Miranda

Project Title: *Neurogenic Stunned Myocardium in Brain Dead Organ Donors*

Primary Mentor: Katherine Fitting, Donor Alliance

Thematic Area: Clinical Science

Abstract:

INTRODUCTION/PURPOSE

Neurogenic Stunned Myocardium (NSM) is a reversible condition seen in the setting of brain injury and is characterized by severely reduced ejection fractions (EF) and left ventricle wall motion abnormalities, most notably global hypokinesis and basal pattern of left ventricle dysfunction. NSM is believed to be caused by a transient release of catecholamines that act directly on myocytes, causing global dysfunction. Sometimes used interchangeably with Takotsubo cardiomyopathy (TCM), key distinguishing characteristics in clinical and demographic findings indicate NSM as a more appropriate terminology in referring to the syndrome seen in the brain dead (BD) population. In studying the characteristics of patients who develop NSM in the BD population, as well as the characteristics of those with the condition who improve, this study hopes to determine the impact on heart donation and subsequent transplant function, creating a guide to donor management with timeframes for heart function improvement.

METHOD

This retrospective chart review evaluated organ donors in a single Organ Procurement Organization (OPO) service area (Denver and Wyoming, estimated population of 5.5 million) between January 2014 and April 2018. We identified 326 potential heart donors, 40 of whom were diagnosed with NSM based on reduced EF (<50%) and/or wall motion abnormalities. These patients were further subgrouped based on those who went on to become successful cardiac donors and those who did not. Extensive chart review was performed to collect patient data, including baseline characteristics, cause of death, downtime (in minutes), and electrocardiography and electrocardiogram data. Comparisons on collected characteristics were analyzed between the non-NSM and NSM groups and between NSM subgroups.

RESULTS

Of the 286 heart eligible donors who did not meet NSM criteria, 59.1% were male (mean age, 34.1 years). Similar distributions of age and gender were seen in the NSM population: 57.5% were male (mean age, 30.8 years;  $p = 0.84$ ). Cause of death (COD) differed significantly in the two groups ( $p = 0.03$ ), with identified causes being anoxia (36.4% vs. 57.5%), cerebrovascular/stroke (24.8% vs. 12.5%), closed head trauma (27.3% vs. 15.0%), and open head trauma (11.5% vs. 15.0%). Median downtime was 0 minutes in both groups, but ranges varied widely (0-180 minutes vs. 0-99 minutes). In the non-NSM group, 59.8% had abnormal electrocardiogram (ECG) findings, while 57.1% of NSM patients demonstrated abnormalities. In both groups, QT prolongation was the most common abnormality encountered (72.5% and 88.5%). Of the 40 patients who met NSM criteria, 19 went on to become successful cardiac donors, while 21 did not. The donation and non-donation patients were of similar age (mean age, 28.6 years vs. 32.7 years;  $p = 0.31$ ), but successful donors were more likely to be male ( $p = 0.009$ ). COD was similar in the two groups ( $p = 0.28$ ): anoxia (47.4% vs. 66.7%), cerebrovascular/stroke (10.5% vs. 14.3%), closed head trauma (15.8% vs. 14.3%), open head trauma (26.3% vs. 4.8%). Echocardiogram results are difficult to interpret in the setting of inconsistencies in timing of the imaging

performed. The initial EF in the donation group was 37.6%, compared to 34.1% in the non-donation group, with both demonstrating a high frequency of global wall motion abnormalities (63.2% vs. 57.1%). All patients in each group underwent a second echocardiogram, with improvement in average EF (55.4% vs. 44.8%). 5 patients in the donation group underwent a third echocardiogram, with average EF in this group 51.5%. The average EF in the third echocardiogram for the 7 non-donation patients was 49.4%.

## CONCLUSIONS

Based on our findings, we recommend against using the first echocardiogram to rule out a brain-dead patient for cardiac donation and continue management so the pathophysiology of catecholamine-mediated myocardiocyte injury has time to reverse. As a soft protocol, we recommend more consideration for younger males who present with reduced EF on initial echocardiogram, as they are more likely to improve. Obtain additional echocardiograms to assess for functional improvement, though continue to clinically manage the donor and evaluate the function and the quality of other organs deemed suitable for transplant. We cannot make definitive predictions on improvement timeframes, but recommend allowing the donors adequate time to recover, though not to exceed 48 hours, as the donor may become unstable and put the other organs at risk. At the 48-hour mark, it is appropriate to conclude the heart as unsuitable for transplant and proceed with recovery of other organs. Clinically supporting the donors, obtaining serial echocardiograms, and allowing time for improvement of myocardial function can positively impact the number of hearts transplanted.

Primary Presenter: Roya Mirhossaini

Project Title: *Utilization Patterns of Fellowship-Trained Mohs Surgeons in the Treatment of Merkel Cell Carcinoma*

Primary Mentor: Mariah Brown, Dermatology

Thematic Area: Clinical Science

Abstract:

Merkel cell carcinoma (MCC) presents a challenge to dermatologic surgeons due to lack of consensus on the efficacy of treatment approaches. New evidence suggests that Mohs micrographic surgery (MMS) reduces local persistence and regional metastasis of the disease as compared to the standard, wide local excision (WLE).[1] Due to the rarity of this disease, studies are limited by small sample sizes and short follow-up periods, and thus WLE remains the standard of care. Since the standard of care for MCC and the role MMS should or should not play for this disease has not been thoroughly established, we surveyed current members of the American College of Mohs Surgery (ACMS) to better understand the role MMS current plays as a treatment for MCC. A total of 91 dermatologic surgeons practicing in either a university or private setting were surveyed via a link in the ACMS monthly bulletin. 57% of respondents treat, on average, at least one MCC per year. A slight majority (54%) do not use MMS for MCC. For those that do perform MMS for MCC, 33% of those physicians report taking a final stage for permanent histopathology in greater than 25%. The results of our study indicate that MMS, though a viable, cost-effective alternative to WLE remains underutilized while exemplifying relative heterogeneity in the treatment of MCC.

Primary Presenter: Eric Montgomery

Project Title: *Review of the Pathophysiology of Primary/Hereditary Heterotopic Ossification in the Context of a Surgical Case*

Primary Mentor: Brian Shaw, Pediatric Orthopedic Surgery

Thematic Area: Clinical Science

Abstract:

This is a review of the current literature and pathophysiology of primary/hereditary heterotopic ossification in the context of a surgical case. The case is a 17-year-old male with progressive superficial and deep heterotopic ossifications localized to his right foot, left shoulder, and left trapezius muscle with suspected progressive osseous heteroplasia (POH) causing significant symptoms. He has a family history significant of a father and a sister with similar patterns of heterotopic ossification. His sister was treated with surgical excision of heterotopic ossification localized to her left foot with good relief of her symptoms. Surgical treatment has been considered contraindicated for individuals with progressive osseous heteroplasia due to concerns of complications and extensive recurrence. However, we hypothesized that focal surgical resection would provide symptomatic relief and surgical treatment would be a reasonable option for the treatment of focal, isolated heterotopic ossification in the context of our patient. Due to the rarity of the disease process, we reviewed the pathophysiology and the current literature and we strived to further characterize, report, and expand the current fund of knowledge regarding hereditary heterotopic ossification disease processes.

Primary Presenter: Joe Morales

Project Title: *Risk Stratification for Ankle Fractures in Patients with Diabetes*

Primary Mentor: Ken Hunt, Orthopedics

Secondary Mentor(s): Daniel Moon

Thematic Area: Clinical Science

Abstract:

Background

Diabetes is a well-known risk factor for morbidity following surgical fixation of ankle fractures. To date, no studies have identified specific diabetes-associated factors that increase the risk of complications for patients with diabetes suffering ankle fractures. We hypothesize that when compared to patients without diabetes, patients with diabetes suffer significantly more complications after undergoing surgical fixation of ankle fractures, and the risk of these complications will be directly associated with the number of comorbid factors.

Methods

At our university medical center, we queried the medical record using ICD-9 and ICD-10 codes to identify subjects with diabetes that sustained an ankle fracture over a six and a half year time frame. A retrospective chart review was then performed, examining fracture characteristics, treatment method, and patient clinical and laboratory factors. Outcome measures included time to union, wound complication, infection, hardware failure, and need for additional surgery. We defined major complications as deep infection, amputation, malunion or nonunion, skin graft, or wound complication. Bivariate analyses and logistic regression were used to examine the relationships complications and clinical factors.

Results

Bivariate analyses showed that patients who have diabetes with ankle fractures and developed complications from the fracture had a significantly higher rate of renal disease ( $p = 0.032$ ) and retinopathy ( $p = 0.020$ ), and considerably more hospital readmissions ( $p = 0.001$ ) than those who did not have complications. The logistic regression model showed that for each one-unit increase in the Charlson Comorbidity Index (CCI) Score, there is a 40.60% increase in the likelihood that a major complication will be present among patients with diabetes and ankle fractures ( $p = 0.025$ ).

Conclusion

Patients with diabetes-related comorbidities have a significantly higher risk of complications following surgical treatment of ankle fractures. In this cohort, renal disease and retinopathy were found to be significantly associated with major complications. Interestingly, neuropathy, smoking, and HbA1C were not independent predictors of major complications in this group.

LEVEL OF EVIDENCE: Level III

Primary Presenter: Mallory Myers

Project Title: *Interaction and Effects of the Novel HCN4-Associated Proteins Hint1 and Hint2 on HCN4 Ion Channels*

Primary Mentor: Catherine Proenza, Department of Physiology and Biophysics, Department of Cardiology

Thematic Area: Basic Biomedical Science

Abstract:

Heart rate is driven by specialized tissue in the heart called the sinoatrial (SA) node. SA node cells have ion channels in their membranes that allow them to function as the heart's pacemaker. One important channel is the hyperpolarization-activated cyclic nucleotide-gated channel 4 (HCN4), which allows sodium and potassium ions to flow into the SA node and create the electrical current needed to start each heartbeat. HCN4 channel mutations are implicated in numerous cardiac diseases. We have identified two new proteins, Hint1 and Hint2, which may interact with the HCN4 channel and affect its activity. The purpose of our study is to determine if Hint1 and Hint2 physically interact with HCN4. We transfected a line of human embryonic kidney (HEK) cells stably expressing HCN4 with a Hint1 construct tagged with green fluorescent protein (GFP), used SDS-PAGE and Western blots to confirm expression, and performed a series of co-immunoprecipitations (co-IPs) from the HEK cell lysates with anti-HCN4 and anti-GFP antibodies. We were unable to confirm a direct interaction between HCN4 and Hint1 because 1) our controls non-specifically interacted with HCN4 and Hint1, 2) our anti-Hint1 antibody demonstrated non-specific binding, and 3) when Hint1 is tagged with GFP, it loses its activity against HCN4. We then transfected a line of HEK cells stably expressing HCN4 with Hint2 and grew a line of Chinese hamster ovary (CHO) cells stably expressing both HCN4 and endogenous Hint2. We performed a series of co-IPs from HEK and CHO cell lysates with anti-HCN4 and anti-Hint2 antibodies. We saw evidence of a direct interaction between HCN4 and Hint2 in lysates from CHO HCN4 cells. In conclusion, we have evidence that HCN4 and Hint2 physically interact, but we still do not know if HCN4 and Hint1 physically interact. Nevertheless, we have evidence that both proteins modulate HCN4 function. Further studies are needed to determine the specific domains and pathways of interaction. Understanding how Hint1 and Hint2 interact with HCN4 may someday direct the development of new therapeutics to control heart rate and treat patients with HCN4 channel mutations.

Primary Presenter: Meghan Nedic

Project Title: *Determinants of childhood mortality and malnutrition rates in tribal populations of India: A Literature Review*

Primary Mentor: Madiha Abdel-Maksoud, Global Health

Thematic Area: Global Health

Abstract:

Rates of childhood malnutrition and mortality among tribal populations in India are disproportionately high compared to the country as a whole. Despite the availability of government healthcare facilities and incentives, a 2018 report from the Tribal Health Expert Committee in India asserts that the “scheduled tribe infant mortality rate in India was highest in the world among the indigenous populations, next only to the Federally Administered Area in Pakistan.” This literature review explores what the major determinants of childhood mortality and malnutrition are and what programs the government has implemented to address this issue.

Primary Presenter: Xuan Thuy Nguyen

Project Title: *The Role of a One Health Interdisciplinary Curriculum Between Medical and Veterinary Students*

Primary Mentor: Roberto Silva, Family Medicine / Rural Track

Secondary Mentor(s): Dr. Mark Deutchman

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Animals and humans share susceptibility to numerous diseases, allowing for animals to serve as a warning sign of potential human illness. The term 'One Health' comes from the idea that the health of animals and humans are essentially 'one' and that there should never have been a separation between the two. Nowadays, the goal of One Health is to encourage collaborative interdisciplinary efforts to achieve the best health outcome for humans, animals, and the environment. Our goals in this project, through the collaborative efforts between students of the University of Colorado School of Medicine (CUSOM) and the University of Colorado Physician Assistant Program (UCPAP) with Colorado State University College of Doctor of Veterinary Medicine students (CSUDVM), is to provide a more meaningful educational experience for students and patients than intra-professional education alone by identifying the connections between human and animal health. Our methods include organizing conferences for medical and veterinary students, hosting events for joint learning, and evaluating the benefits of a One Health model of interprofessional education as reported by the students themselves to improve the rural track curriculum.



Primary Presenter: Bao-Tran Nhan

Project Title: *Upgrading Multiple Choice Question Items in Cardiovascular, Pulmonary, Renal Block to Meet National Board of Medical Examiners Standards*

Primary Mentor: William Sather, CVPR Block Director

Secondary Mentor(s): Daniel Goldberg

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

An important step in earning medical licensure in the United States is passing Step 1, a United States Medical Licensing Examination (USMLE) exam used to assess medical knowledge and clinical skills. USMLE Step 1 items are written by the National Board of Medical Examiners (NBME), an organization that provides item-writing guidelines for crafting medical school course exam items. Qualitative guidelines include a list of exam writing errors classified as technical errors and errors of testwiseness. Quantitative guidelines provide standards for statistical indices used to measure exam item quality. The goal of our study is to assess the impact of item revision based on NBME item-writing guidelines on item quality and student exam performance. Two cardiovascular exams were modified items and administered during the 2018 Cardiovascular, Pulmonary, and Renal (CVPR) systems course at the University Colorado School of Medicine. Psychometric parameters such as item discrimination, difficulty, and reliability were used to compare the item quality of 2017 and 2018 exams. The results suggest that exam revisions improved the item quality of the CVPR exams by increasing item discrimination and decreasing the number of items with negative item discrimination while maintaining exam reliability. By improving the item quality, we aim to better assess the clinical knowledge of students and prepare students for NBME-style questions on USMLE Step 1. In the future, exam data of subsequent years and student USMLE Step 1 scores should be analyzed to explore the effect of improving item quality on USMLE Step 1 scores.

Primary Presenter: Cameron Niswander

Project Title: *Acute Disease Exacerbation with Associated Changes in Climate in the San Luis Valley of Colorado*

Primary Mentor: Katherine James, School of Public Health

Thematic Area: Public Health and Epidemiology

Abstract:

Background

Environmental factors associated with global climate change have and will continue to exacerbate chronic health conditions in humans. These acute-on-chronic episodes lead to increased morbidity and mortality for chronically-ill patients. This study investigates the relationship between climate factors and acute exacerbations of chronic disease in a rural population in the San Luis Valley of Colorado.

Methods

This is a retrospective cohort study with a time-series analysis of climate factors (air quality, humidity, and temperature) and associated adult urgent care/emergency room visits (UC/ER) at healthcare facilities in Alamosa, Colorado. Individuals over 18 years, diagnosed with myocardial infarction (MI), stroke, exacerbation of chronic heart failure (CHF), or urolithiasis who visited these facilities from 2013-2017 were included. Linear models with cubic splines and general estimating equations were employed for analysis.

Results

1311 patients presented to UC/ER for complaints including MI (388), stroke (270), CHF (653), and urolithiasis (927). Maximum daily temperature (MDT) was associated with a significant increased risk of MI (OR 1.01 per degree C, 95% CI: 1.00-1.02) and risk of urolithiasis (OR 1.01 per degree C, 95% CI: 1.01-1.02). Increased humidity was associated with an increased risk of urolithiasis (OR 1.08 per 10%, 95% CI: 1.01-1.15).

Conclusion

There is an increased risk of MI and urolithiasis with increasing MDT despite the mild mean temperature of the region. This may be indicative of relative heat extremes rather than absolute thresholds due to local acclimatization. Outcomes such as MI are of particular concern in a rural population with delayed access to care.

Primary Presenter: Laurel Officer

Project Title: *The Youth Community Health Awareness Partnership: Community-based participatory research initiative to assess the scope of alcohol use within the community of refugees from Burma in the greater Denver area*

Primary Mentor: Janet Meredith, CU Dept of Family Medicine

Secondary Mentor(s): Jamaluddin Moloo

Thematic Area: Global Health

Abstract:

#### BACKGROUND

For more than fifty years, minorities in Burma have faced severe persecution and violence that has forced them to flee their homeland. In the past ten years there has been an influx in the number of refugees resettled in Denver. Refugees often struggle to navigate the complexities of the American health care system and adapt to life in a foreign culture. The development of novel programs and partnerships to assist refugees in their pursuit of health and integration is essential to build stronger, cohesive communities.

#### METHODS

Beginning in 2014, a multi-phase community based participatory research (CBPR) project was developed in collaboration with the refugee community from Burma residing in the greater Denver area. The first phase of the project involved establishing a partnership with the community. A group of motivated teenagers and young adults from this community collaborated to form our Youth Advisory Board (YAB). We met regularly with the YAB to discuss and prioritize health issues. They identified alcohol use and misuse as the paramount health concern within their community. Formative information was elicited from community leaders, local refugee organizations, healthcare providers, and informal surveys to guide future research tools. With this identified issue, the project moved into phase two of data collection. Phase two involved conducting formal one-on-one, semi-structured, audio-recorded interviews with community members. Participants were recruited voluntarily at health information nights held by the student researchers at their local apartment complex. The interviews were conducted by one medical student researcher with one translator present and were transcribed afterward. Phase three, the current phase of the project, includes data analysis and presenting our findings to the community. The interview data was analyzed using Immersion Crystallization methodology. This data will be leveraged to create, implement, and evaluate a culturally competent intervention to effectively address risky alcohol use in this affected community.

#### RESULTS

Initial results from the nineteen meetings with the YAB, fourteen meetings with local organizations, nineteen formative community surveys, and three key informant interviews pointed to the vulnerability of the refugee population, the scarcity of culturally appropriate resources for alcohol abuse, and the urgency of addressing problematic alcohol use. The analysis of the ten audio-recorded surveys showed the emergence of several themes related to the use of alcohol within this community. Themes identified through qualitative analysis include negative consequences of alcohol use, specifically negative impacts

on familial relationships, employment, and financial resources, and a perceived personal responsibility for managing one 's own alcohol consumption.

#### CONCLUSIONS

This project corroborates current literature regarding the scope and breadth of hazardous alcohol use within the community of refugees from Burma. Our data has expanded our understanding of the values of community members including the influence of religion and family on behaviors, and the negative impact on employment as the most impactful negative consequence. These findings need to be shared with the community to move forward in mapping the most effective and appropriate interventions.

Primary Presenter: Zoe Panchal

Project Title: *Transgender Mental Health Care: Experiences, Preferences and Outcomes*

Primary Mentor: Robert Davies, Psychiatry

Thematic Area: Public Health and Epidemiology

Abstract:

Transgender populations have high rates of many mental health concerns, indicating a need for supportive and effective transgender mental health care. However, at this time the features of such care are not well defined. We conducted a narrative review of empirical research on mental health care experiences, preferences and outcomes for transgender populations in order to synthesize current understandings of these issues. Results indicate that transgender individuals have a wide range of experiences across mental health care settings, with several articles reporting outcomes data. We discuss preliminary features of supportive transgender mental health care and gaps in the literature.

Primary Presenter: Harin Parikh

Project Title: *Peripheral Nerve Blockade and Limb Strength Asymmetry after Primary Anterior Cruciate Ligament Reconstruction in Pediatric Patients*

Primary Mentor: Tessa Mandler, Anesthesiology

Secondary Mentor(s): Dr. Jay C. Albright, Department of Orthopedics

Thematic Area: Clinical Science

Abstract:

Background

The long-term effects of single-injection femoral nerve blockade (FNB) and femoral nerve catheter (FNC) placement after anterior cruciate ligament reconstruction (ACLR) are not well defined among pediatric patients. FNB has been associated with knee extension and flexion strength deficits at 6 months.

Aims

We compared outcomes after primary ACLR in pediatric patients who received either FNB or FNC and a single-injection popliteal nerve block.

Methods: We conducted a retrospective chart review of patients 10-19 years of age who underwent ACLR with quadriceps tendon-patellar bone autograft by a single orthopedic surgeon at two of our locations. Of 88 patients analyzed, 31 received FNB (52% female, mean age=15.6 ±1.8 years) and 57 received FNC (53% female, mean age=15.6 ±1.7 years). Time from surgery to return-to-sport clearance and movement symmetry were compared between groups at approximately 6 months postoperatively. Additionally, we compared the proportion of patients who had initiated ballistics and running programs in physical therapy and obtained full knee flexion and extension range of motion.

Results

The FNB group exhibited significantly greater single-leg squat symmetry than did the FNC group (95.5 ±6.7% vs. 88.3 ±9.3%; p=0.02) at follow-up. Time from surgery to return-to-sport clearance was not significantly different between groups (median=247 [interquartile range=218-295] days vs. 268 [241-331] days; p=0.22).

Conclusion

Though time to return to sport did not differ, patients in the FNC group exhibited greater single-leg squat asymmetry than did those in the FNB group approximately 6 months postoperatively. Persistent functional deficits may be important to consider when treating pediatric patients undergoing ACLR.

Primary Presenter: Rachel Pauley

Project Title: *Exploring the Impact of Housing Insecurity on Inpatients at the University of Colorado Hospital and Denver Health*

Primary Mentor: Greg Misky, Hospital Medicine

Secondary Mentor(s): Erin Bredenberg, MD, Division of Hospital Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

The interaction between housing and health are complex. Housing insecurity is associated with increased comorbidities, higher morbidity, and higher rates of mortality. Understanding the unique challenges faced by patients experiencing housing insecurity is a crucial step to creating patient-centered interventions to improve health outcomes. This pilot study uses in-depth, in-person, semi-structured interviews (n 15 – 40 at each site) with patients experiencing housing insecurity at the University of Colorado Hospital and Denver Health in Colorado to gain insight into the ways in which housing insecurity interacts with health. Quantitative data, including length of stay and readmission rates, are compared to those of stably housed counterparts. Researchers are currently conducting interviews and thematic analysis of transcripts. This research will further knowledge about housing insecurity's impact on inpatient health in Colorado and offer opportunities for quality improvement and policy change.

Primary Presenter: Megan Perez

Project Title: *A Preoperative Mathematical Model to Estimate Available Tissue Length for Ureteral Reimplantation by Different Methods of Bladder Mobilization*

Primary Mentor: Granville Lloyd, Urology

Thematic Area: Clinical Science

Abstract:

#### Introduction

Ureteral injury occurs after pelvic surgery at a rate that has been estimated to range from 0.2-9% of cases; other causes of iatrogenic ureteral damage include endoscopic surgery, malignancy, radiation and external trauma<sup>1,4,5,6, 10</sup>. These injuries are commonly repaired with ureteral reimplantation. Depending on the location of the ureteral injury, complex reconstruction techniques utilizing the bladder may be required. This is especially the case when the lesioned ureter is not long enough to reimplant into the bladder without creating excessive tension<sup>15</sup>. One method that can be used is a Boari flap, which utilizes bladder tissue to bridge the distance to viable proximal ureter<sup>14</sup>. Accurate preoperative estimation of the amount of bladder tissue length available after bladder mobilization, with or without advancement flap (Boari flap or Psoas hitch), is desirable. We aimed to create a graphical tool to estimate the distance that can be generated from the base of the bladder after maximal mobilization toward ureteral reimplantation, based on bladder volume. By using the equation for volume and circumference of a sphere, we created a mathematical model for the estimation of maximal generated length from bladder for ureteral reimplantation in the setting of distal ureteral loss.

#### Methods

A curve was generated by solving  $V = \frac{4}{3} \pi \left(\frac{c}{2\pi}\right)^3$  resulting in. Circumference was then divided by 2 to calculate  $\frac{1}{2}$  circumference from bladder volume (Fig. 2). This data was used to calculate the total theoretical length produced after full bladder mobilization for a simple direct reimplantation. An additional 4cm of length was then added to those values to account for the additional length that Boari flap adds, which is demonstrated in Figure 3.

#### Results

Using the aforementioned equation, we were able to graphically demonstrate the relationship between bladder volume and the length that can be generated for simple direct reimplantation of the ureter and Boari flap.

#### Conclusions

We present a mathematical model for the estimation of maximal generated length from bladder for ureteral reimplantation in the setting of distal ureteral loss. Knowledge and usage of this model may prove beneficial in complex and difficult reconstructions for accurate surgical planning. This mathematical model awaits validation in vivo, and suffers from limitations including the inability to estimate additional length from bladder compliance, as well as limitation of mobilization from fixation at the contralateral vascular pedicle. Bladder volume provides a useful estimate of available tissue for preoperative planning in the setting of ureteral loss of length.



Primary Presenter: Zachary Pfeifer

Project Title: *Metabolomic Fingerprinting of Infants Undergoing Cardiopulmonary Bypass: Changes in Metabolic Pathways and Association With Mortality and Cardiac Intensive Care Unit Length of Stay*

Primary Mentor: Jelena Klawitter, Anesthesia

Thematic Area: Clinical Science

Abstract:

Mortality and complications rates are poor in infants undergoing complex cardiac surgery. Earlier identification of infants at risk for adverse mortality or complication events would be beneficial for improving outcomes. Metabolites are the small molecules that serve as the intermediate products of all cellular processes and can reflect the rapidly changing cellular phenotype following surgical intervention and identify metabolic pathways that may be intervened upon. We measured 165 serum metabolites by tandem mass spectroscopy in infants  $\approx$ 120 days old undergoing cardiopulmonary bypass (CPB) for cardiac surgery. Samples were collected pre-bypass, during rewarming, and 24 hours after surgery. Samples were evaluated for changes in the metabolome, to assess altered metabolic pathways, and to discriminate between survivors/non-survivors as well as upper/lower 50% intensive care unit length of stay. Analysis revealed differences in baseline metabolic levels between neonates and infants, Cardiopulmonary bypass resulted in progressive, age  $\in$ dependent metabolic disturbance, and identified pathways that exhibited changes associated with poor outcomes including aspartate and nicotinate/nicotinamide metabolism. These findings exhibit the maturation of metabolism from neonates to infants, the drastic shifts in metabolism that occur in response to CPB, and pathways that identify high risk patients.

Primary Presenter: Andy Phan

Project Title: *Hypofractionated Radiotherapy Is Superior to Conventional Fractionation in an Orthotopic Model of Anaplastic Thyroid Cancer*

Primary Mentor: Sana Karam, Radiation Oncology

Thematic Area: Basic Biomedical Science

Abstract:

#### BACKGROUND

Anaplastic thyroid cancer (ATC) is an aggressive and highly lethal disease with poor outcomes and resistance to therapy. Despite multimodality treatment, including radiation therapy and chemotherapy, response rates remain <15%, with a median time to progression of less than three months. Recent advances in radiotherapy (RT) delivery and gene-expression profiling may help guide patient selection for personalized therapy. The purpose of this study was to characterize the response to radiation in a panel of ATC cell lines and to test alternative RT fractionation schedules for overcoming radioresistance.

#### MATERIALS AND METHODS

The cellular response to radiation was characterized based on clonogenic assays. Radiation response was correlated with microarray gene-expression data. Hypofractionated and conventional RT was tested in an orthotopic ATC tumor model, and tumor growth was assayed locally and distantly with in vivo and ex vivo bioluminescence imaging.

#### RESULTS

A spectrum of radiosensitivities was observed in ATC cell lines. Radioresistant cell lines had higher levels of CXCR4 compared to radiosensitive cell lines. Compared to conventionally fractionated RT, hypofractionated RT resulted in significantly improved tumor growth delay, decreased regional and distant metastases, and improved overall survival.

#### CONCLUSIONS

The findings demonstrate the heterogeneity of response to radiation in ATC tumors and the superiority of hypofractionated RT in improving local control, metastatic spread, and survival in preclinical models. These data support the design of clinical trials targeting radioresistant pathways in combination with hypofractionated RT.

Primary Presenter: Erik Polsdofer

Project Title: *Metformin promotes triple negative breast cancer cells undergoing apoptosis via induction of TRAIL*

Primary Mentor: Bolin Liu, Department of Genetics, Stanley S. Scott, Cancer Center, LSU Health Sciences Center

Thematic Area: Basic Biomedical Science

Abstract:

**Purpose of Study**

Triple negative breast cancer (TNBC) does not respond to conventional targeted therapy, necessitating novel treatment options. Metformin possesses unique anti-proliferative and pro-apoptotic properties in TNBC cells. However, the mechanism of action of metformin is incompletely understood. In the current study, we aim to determine the involvement of tumor necrosis factor-related apoptosis-inducing ligand (TRAIL)-mediated apoptotic signaling in metformin-induced antitumor effects on TNBC cells.

**Methods**

Used TNBC cell lines BT549, HCC70, HCC1806, HCC1937, and MDA-MB-468 were cultured. The levels of pro-caspase 8, cleaved caspase 8, pro-caspase 3, cleaved caspase 3, PARP, and TRAIL were examined by Western Blot assays. Quantification of apoptosis was determined by a cell death detection ELISA kit measuring cytoplasmic histone-associated DNA fragments (mono- and oligonucleosomes). A soluble recombinant TRAIL decoy receptor, which contains a normal extracellular domain of death receptor 5 (DR5) but a truncated intracellular domain and thus is unable to transduce death signals, was used to block TRAIL function. Lentiviral vector containing specific shRNAs was used to knockdown TRAIL expression.

**Summary of Results**

BT549, HCC70, HCC1806, HCC1937, and MDA-MB-468 cells showed increased apoptosis upon metformin treatment on Western Blot analysis and apoptotic ELISA as well as increased TRAIL protein expression in a dose-dependent manner as compared to controls. Blockade of TRAIL function with the recombinant TRAIL decoy receptor or specific knockdown of TRAIL expression significantly attenuated metformin-induced PARP cleavage, activation of caspase-8 and caspase-3, and DNA fragmentation as compared to controls in BT549, HCC70, and MDA-MB-468 cells.

**Conclusions**

TNBC cells demonstrated increased apoptosis and upregulation of TRAIL expression upon metformin treatment. Inhibition of TRAIL function or specific knockdown of TRAIL expression significantly reduced metformin-induced apoptosis in TNBC cells. Our data indicated that TRAIL induction and TRAIL-mediated signaling pathway played a critical role in metformin-induced apoptotic effects on TNBC cells.

Primary Presenter: Scott Powers

Project Title: *Outcomes comparing autograft quadriceps tendon and hamstring tendon in ACL reconstructive surgery*

Primary Mentor: Alexander Meininger, Laboratory (Basic) Science

Secondary Mentor(s): Alexander Meininger

Thematic Area: Clinical Science

Abstract:

Tears of the anterior cruciate ligament (ACL) are a frequent injury that results in functional disability for patients. Over 200,000 ACL tears are anticipated annually in the United States<sup>40</sup>. Multiple techniques and graft types are described for ACL reconstructive surgery including autografts such as bone-patellar tendon-bone, hamstring and quadriceps tendon. Soft tissue grafts are gaining popularity and there is no consensus as to which provides the best functional outcomes for patients.

In this study, we sought to compare one surgeon 's cohort of patients treated with quadriceps tendon autografts (QT) with those who received hamstring tendon autografts (HT) for ACL reconstructive surgery. Patients were surveyed preoperatively, and after surgery with intervals at 2 weeks, 6 weeks, 3 months, 6 months, and one-year with visual pain analog scales (VAS), Knee Injury and Osteoarthritis Outcome Score (KOOS), Veteran RAND score (VR-12), and International Knee Documentation Committee (IKDC) surveys. Additionally, patients receiving quadriceps autografts were compared at one year to patients receiving hamstring autografts by IKDC scores.

The quadriceps group showed improvements in their KOOS and IKDC scores at 6 months in all categories and improvements in functional scores at one year ( $p$ -value $<0.05$ ). However, QT patients did not have improvements in their VR-12 mental scores at any time period. No significant difference was identified between the quadriceps and hamstring groups at their one-year IKDC scores. Loss to follow-up was 41.1% in the hamstring group and 82.2% in the quadriceps group at one year. The outcomes of this study demonstrate similar improvements in patient-reported outcomes for patients receiving quadriceps tendon as compared to patients receiving other autografts and show non-inferiority and possible superiority of the quadriceps tendon as compared to the more frequently used hamstring tendon autograft.

Primary Presenter: Ashley Quick Bear

Project Title: *Working to End Teen Obesity*

Primary Mentor: Janet Meredith, Family Medicine

Secondary Mentor(s): Don Nease

Thematic Area: Public Health and Epidemiology

Abstract:

**Background & Objectives**

Approximately 1 in 5 teenagers in the United States were obese in 2015, a number that has quadrupled since 1980 with projections indicating continued rise. Adolescent obesity is associated with significant physical and psychosocial comorbidity; however, clinicians often fail to motivate teenagers to lose weight. This research investigates potential causes and solutions for this failure by evaluating current clinic-based communication strategies and developing new methods through community based participatory research.

**Methodology**

Methods used to evaluate patient and provider perspectives surrounding weight-based communication included surveys and focus groups. Standardized focus group interviews were conducted with teenagers from Aurora, Colorado high schools. Interviews were audio-recorded, transcribed, and qualitatively analyzed using open coding by three separate coders. Electronic and paper surveys were distributed to healthcare providers across Colorado in family medicine, pediatrics, and behavioral health who reported counseling teenagers in their practice. Physician survey responses were analyzed by summary statistics and open coding.

**Results**

3 gender-separated focus groups for a total of 6 groups, each with 8-10 participants, were interviewed (n = 47). Five themes arose from these discussions: (1) know the teen before discussing weight; (2) avoid using Body Mass Index (BMI); (3) elucidate the teen 's motivations; (4) personalize goals for the patient; (5) include frequent follow-up and encouragement. 170 completed provider surveys were collected, revealing that practitioners were comfortable initiating conversations, though most used BMI to open discussions despite its patient reported inefficacy, felt ineffective in promoting weight-related change, and saw a need to improve their interactions via adopting teen-approved strategies.

**Conclusions**

Teen-approved methodologies for updating providers on successful weight management counseling should be developed, tested, and implemented to promote positive patient-provider interactions and enhance effective weight related changes in teen patients.

Primary Presenter: Kelsey Repine

Project Title: *Facing Burnout: The Gift of Gratitude*

Primary Mentor: Steven Lowenstein, Emergency Medicine

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Burnout, depression, anxiety, and suicide are highly prevalent and increasing concerns during medical school, residency training, and throughout clinical practice. Combating burnout early in training and developing resiliency techniques is critical to both enhance a medical professional's well-being and success but also improve patient care and outcomes through more compassionate care. During my third and fourth years as a medical student, I led a novel Gratitude Journal Project that sought to foster student wellness and resiliency and promote more reflective and humanistic patient care.

The Gratitude Project

In collaboration with a multidisciplinary team of medical students, physicians, faculty, and administrators, I and another fourth-year medical student, Oliver Bawmann, developed a new intervention called the "Gratitude Journal." The purpose of the Gratitude Journal was to help medical students at the University of Colorado School of Medicine combat burnout. We also enlisted the important support of multiple organizations at the University of Colorado including the Offices of Student Life and Faculty Affairs, the Gold Humanism Honor Society, the School of Medicine faculty, and the Arts and Humanities in Healthcare Program. In addition, we secured a generous grant from the Society for Professionalism in Medicine that helped fund the printing of more than 300 copies of the Gratitude Journal. The Gratitude Journal encourages students to write down three things they are grateful for every day. In so doing, the Gratitude Journal provides a vehicle for positive grounding and reflection for individuals training or practicing medicine in stressful situations. Individuals who practice gratitude have higher job and personal satisfaction. Having students, residents, fellows, and faculty practice gratitude in tangible ways holds great potential for advancing medicine.

Methods

We created a Gratitude Journal with each page designating a specific day and providing a space to write daily three things for which one is grateful. Each page has space for multiple years under each day (for example, under August 12, there is space for gratitude reflection for years 2020, 2021, 2022, 2023). This format is designed to incorporate a reflective component when practicing gratitude - it provides the writer with the opportunity to reflect on changes that occur not only day after day but also year after year. In the latter case, it is the meaningful chance to say "Wow, look how far I have come from last year!" or "I still remember that patient from two years ago who made me laugh!" or "I was grateful for the support I received from my classmates two years ago, and I still am!

Additionally, as a reflection of the faculty's involvement and commitment to supporting student well-being, we asked the entire faculty to voluntarily submit quotations, reflections, and comments regarding their expressions of gratitude. We were met with enthusiasm and secured more than 50 quotations that are interspersed strategically throughout the journal. At the end of the journal, we included 10 tear-out postcards with the title, "Today I am grateful for" to provide an easy way to share and evoke gratitude in someone else.

## Results

I presented and described the purpose of the Gratitude Journal to the University of Colorado School of Medicine 's rising third-year students at their Student Clinician Ceremony (May, 2019) and to our newest first-year students at their White Coat Matriculation Ceremony (August, 2019). This effort sent a clear message about our dedication to student wellness during the medical school journey. We also recently published an essay describing the rationale, methodology, and story of the creation of the Gratitude Journal in Colorado Medicine. In addition, we submitted a Letter to the Editor of Academic Medicine regarding the Gratitude Journal that is currently under review. The Gratitude Journal created and has been met with widespread enthusiasm.

## Conclusions

To our knowledge, the Gratitude Journal that we specifically created for and distributed to medical students with the goal of combating burnout in medical training is the first of its kind. More than just for benefiting medical students, the Gratitude Journal is an innovative device for promoting wellness among individuals on the University of Colorado Anschutz Medical Campus. It is anticipated that a Gratitude Journal will be distributed yearly to entering medical students at the White Coat Ceremony and, accordingly, promote wellness through the lens of gratitude. The Gratitude Journal launches a new tradition at the University of Colorado School of Medicine. One day, we hope that the Gratitude Journal will become a part of the culture at the University of Colorado Anschutz Medical Campus and that all faculty, residents, fellows, and employees will use gratitude journals to combat burnout and remind them of the joys of practicing medicine.

Primary Presenter: Dillon Riebel

Project Title: *Decreasing Hospital Readmissions for Preeclampsia in the Postpartum Period*

Primary Mentor: Katlynn Adkins, Obstetrics and Gynecology

Secondary Mentor(s): Jonathan Steller MFM Fellow

Thematic Area: Clinical Science

Abstract:

**Objective**

Preeclampsia affects 2-8% of pregnancies worldwide. Preeclampsia diagnoses in the postpartum period are not well studied and are a major contributor to maternal morbidity as well as additional financial costs to patients and the healthcare system. This study 's purpose is to evaluate peripartum characteristics, with an emphasis on hypertension and fluid management, that may help predict which UHealth patients are high risk for postpartum preeclampsia readmission to the hospital. This data will be used to develop quality improvement measures aimed at reducing such readmissions.

Study design: This is a single center retrospective study of women readmitted to UHealth through an emergency department encounter within 42 days of delivery with a diagnosis of any hypertensive disease of pregnancy.

**Results**

Data from 106 women will be studied. 2709 emergency department encounters were reviewed and 106 women meeting inclusion criteria were identified. Demographic data, medical history, vital signs, fluid and blood pressure management, and postpartum care data were gathered and used to direct future quality improvement changes at UHealth.

**Conclusion**

UHealth has the opportunity to improve its intra- and postpartum management of women with, or at risk for, hypertensive disorders of pregnancy. In particular, standardization of fluid charting and blood pressure check scheduling stand out as areas in need of improvement. Quality improvement measures aimed at these and other aspects of peripartum care at UHealth will hopefully lead to a reduction in preeclampsia readmissions in 2020 and beyond.



Primary Presenter: David Robertson

Project Title: *The impact of mobility status on health outcomes after transitioning to adulthood in cerebral palsy a systematic review*

Primary Mentor: James Carollo, Physical Medicine and Rehabilitation, Orthopedics, Biomedical Engineering

Thematic Area: Clinical Science

Abstract:

#### Background

Cerebral palsy (CP) is one of the most prevalent chronic childhood diseases. Growing evidence suggests that individuals with CP have higher risks for comorbidities associated with lifestyle and aging compared to their typically developing peers. Our aim is to evaluate associations between ambulatory ability and health status across the lifespan in individuals with cerebral palsy through systematic review of literature correlating measures of walking ability with indicators of cardiovascular, metabolic, musculoskeletal, and psychological health. We hypothesize that higher levels of ambulatory ability and activity will be associated with reduced cardiovascular disease, obesity, osteopenia, fatigue, pain, spasticity, and contractures and increased quality of life and muscle strength.

#### Methods

This study is a systematic review of literature published in English found from searches of Pubmed, Embase, and review of references of included studies. Two independent reviewers screened abstracts and full text for inclusion criteria. All studies included individuals with CP and at least one outcomes measure of walking ability correlated with at least one indicator of cardio-metabolic, musculoskeletal, or psychological health status. Intervention and validation studies were excluded. Strength of association was determined for each individual health outcome or walking ability outcome by two independent raters using correlation data presented in the paper. Results were grouped by health status outcomes and by mobility outcome quality.

#### Results

Overall 3554 articles published between 1958-2018 were initially identified, 204 abstracts met criteria for full-text review, and 72 studies met full inclusion criteria published between 1991-2015. Study designs were predominately (92%) prospective and retrospective cross-sectional compared to longitudinal (8%). A total sample size of 13201, 40% female, was examined across all health domains. Mean age 17yrs (4-76yrs). Participants were 80% GMFCS I-III and 20% GMFCS IV-V. Since several studies included multiple measures of walking ability, a total of 106 comparisons between walking ability and health status across all health outcome domains. When grouped by health domain, 21 cardiometabolic, 27 musculoskeletal, and 58 psychological comparisons were made with a mobility outcome measure. In total, there were 21 cardiometabolic, 27 musculoskeletal, and 58 psychological mobility comparisons. Overall 67% of cardiometabolic, 85% of musculoskeletal, and 77% of psychological comparisons showed convincing or suggestive association in the expected direction. When only high quality measures of walking ability were used (gait kinematics, overall walking performance, and six-minute walk test) only 19.6% (21/107) of the comparisons remained, (3 cardiometabolic, 13 musculoskeletal, and 5 psychological). Overall 66% of cardiometabolic (2/3), 77% (10/13) of musculoskeletal, and 60% (3/5) of psychological comparisons showed convincing or suggestive associations in the expected direction.

There were no studies included with comparisons showing associations in directions that were not expected.

#### Interpretation

As individuals with CP age, their risk of experiencing declines in health and physical function is greater than the general population, potentially leading to decreased quality of life and early morbidity and mortality. The evidence provided in the current literature examining associations between walking ability and health status suggests that walking performance and function are critical components of health status for individuals with cerebral palsy across the lifespan. Out of all comparisons, 78% showed convincing or suggestive associations between poor walking ability and poor health status. This trend persists when grouped by high quality walking measures and by individual health domains suggesting that walking ability impacts many areas of health. Only 19.6% of comparisons were found to be using high quality walking ability outcome measures highlighting an area for further research. This systematic review is limited by a lack of high quality, longitudinal studies examining associations between walking ability and health. However, it does provide strong evidence of the need for more research examining the association between walking ability and health in individuals with CP.

Primary Presenter: Samuel Russell

Project Title: *Obstructive Sleep Apnea and Early Weight Loss among Adolescents that Undergo Bariatric Surgery at Children's Hospital Colorado*

Primary Mentor: Jill Kaar, Pediatric Endocrinology

Thematic Area: Public Health and Epidemiology

Abstract:

Purpose of study

Adult literature demonstrates impressive results regarding the effect of bariatric surgery in ameliorating obstructive sleep apnea (OSA), however these data are scarce in pediatric literature. As morbid obesity and OSA become increasingly common in adolescents, it is important to quantify the prevalence of OSA and the effects of surgical intervention in this unique, growing population.

Methods used

Retrospective chart review of pre- and postsurgical adolescents and young adults enrolled in the Bariatric Surgery Center at Children 's Hospital Colorado (CHCO) with presurgical and/or postsurgical polysomnography (PSG) between June 2017 and August 2019 (n=70 of 83 total patients). Inclusion criteria was based on availability of presurgical PSG results. Demographic and clinical variables including age, gender, race, comorbidities, PSG results, and weight/BMI change were collected. Pediatric OSA criteria were applied to PSG results to determine presence and severity of OSA. Chi-square and Mann Whitney test for nonparametric data were used to compare baseline characteristics and surgical outcomes between patients with and without preoperative OSA. Subsequent analysis was performed to assess differences in baseline characteristics between patients who resolved their OSA after surgery and those who did not.

Summary of results

The prevalence of OSA among those with preoperative PSG, defined as apnea hypopnea index  $\geq 1$ , was 77% pre-surgery (54/70 patients), with 44% demonstrating severe OSA by OAH1  $\geq 10$  (31/70 patients). There were no significant differences in race, gender, BMI, or comorbidities according to diagnosis of OSA. Of 12 patients with preoperative OSA and a postoperative sleep study, 58% (7/12) resolved their OSA. Average preoperative BMI for resolving patients was  $45.46 \pm 7.32$  versus  $56.76 \pm 6.93$  in those who did not have resolution of OSA ( $p=0.03$ ). Average change in BMI from preoperative to postoperative sleep study was -21.9% in the resolved group and -13.5% in the unresolved group ( $p=0.12$ ).

Conclusion

The prevalence of OSA in the population of adolescents seen in the Bariatric Surgery Center at CHCO was more similar to the estimated prevalence in adults seeking bariatric surgery (77% vs. est. 69-88%) than the general obese adolescent population (45-60%). Resolution of OSA after surgery correlated with lower preoperative BMI, but sample size limited further analysis.

Primary Presenter: Thomas Ryan

Project Title: *Protection of Neurons by Erythropoietin Mediated Through Preservation of Erythropoietin Receptor by Albumin*

Primary Mentor: Brett Reece, Cardiothoracic Surgery

Thematic Area: Basic Biomedical Science

Abstract:

Introduction

Spinal cord damage can occur after aortic surgery, resulting in paraplegia. Potential pharmacologic intervention requires understanding neuroprotective pathways. In one of these key pathways, the tissue protective receptor (TPR), a heterodimer of  $\hat{I}^2$ -common receptor (BCR) and erythropoietin receptor (EpoR), triggers a tissue protective mechanism when activated by erythropoietin (Epo). Post-stroke patients with low albumin have poorer neurologic outcomes and dialysis patients with low albumin are more resistant to Epo treatment of anemia. We hypothesize that albumin preserves EpoR on the neuronal cell membrane, allowing for tissue protection through Epo signaling.

Methods: Neuronal tissue was isolated from neonatal mice and cultured in serum free media. The neurons were then subject to oxygen and glucose deprivation (OGD) for 1 hour to simulate ischemic injury. A factorial design with and without treatment with albumin (2.5%) and Epo (5ng/mL) was employed for OGD groups. BCR and EpoR expression was assessed with a western blot. Neuron survival was assessed with a colorimetric metabolic assay.

Results

EpoR expression was undetectable when albumin was absent from the media. There was no significant difference in normalized BCR expression when albumin was absent from the media ( $p=0.99$ ). OGD alone led to  $61\% \pm 4\%$  viability relative to control ( $p < 0.001$ ). OGD with Epo did not improve viability relative to OGD alone ( $p=0.71$ ). Addition of albumin during treatment with Epo maintained neuronal viability at  $85\% \pm 4\%$  which was significantly better than neurons undergoing OGD alone ( $p = 0.02$ ).

Conclusions

The absence of albumin significantly decreases the EpoR component of the tissue protective receptor to the point that it is undetectable. Epo significantly increases neuron survival when albumin is present but fails to increase neuron survival when albumin is not present. Administration of albumin with no Epo showed a non-significant trend toward increased neuron survival, likely due to albumin's antioxidant properties. The synergistic effects of albumin and Epo administration elucidate a regulatory mechanism in the TPR neuroprotective pathway that could be used to improve outcomes post-neurologic ischemia.

Primary Presenter: Weston Ryan

Project Title: *Pre-contoured Quadrilateral Surface Acetabular Plate Fixation Demonstrates Increased Stability When Compared to Pelvic Reconstruction Plates: A Biomechanical Study*

Primary Mentor: Todd Baldini, Department of Orthopaedics

Secondary Mentor(s): Cyril Mauffrey, MD

Thematic Area: Basic Biomedical Science

Abstract:

### Introduction

Infrapectineal pre-contoured quadrilateral surface buttress (iPQSB) plates are increasingly utilized for fixation of acetabular fractures, despite limited comparative literature to traditional forms of fixation. This study's purpose is to compare the stability of three fixation strategies for a transverse acetabular fracture: a reconstruction plate with anterior and posterior column screws (GroupA); an iPQSB plate alone (GroupB); an anterior column lag-screw and iPQSB plate (GroupC).

### Methods

A transverse acetabular fracture was created in 18 synthetic hemi-pelves. Six were fixed by each of the 3 methods described. Specimens underwent cyclic axial compressive loading to 1700N for 42,000 cycles while anterior and posterior column displacements were measured, followed 4800N for 50 cycles. Displacement and stiffness data were analyzed with ANOVA and Tukey HSD. A Cox Proportional Hazards regression model was used to determine survival rate. P values <0.05 were considered significant.

### Results

GroupC had significantly less posterior column displacement ( $0.16 \pm 0.06\text{mm}$ ) compared to GroupB ( $0.38 \pm 0.37\text{mm}$ ,  $P < 0.0001$ ) and GroupA ( $0.38 \pm 0.37\text{mm}$ ,  $P < 0.0001$ ). Additionally, GroupA had significantly more anterior column displacement ( $0.28 \pm 0.11\text{mm}$ ) than GroupB ( $0.22 \pm 0.14\text{mm}$ ,  $P = .0310$ ) and GroupC ( $0.18 \pm 0.09\text{mm}$ ,  $P = .0001$ ). GroupC was 10.5% stiffer than GroupA ( $P = 0.0037$ ). GroupB had a 7.27x greater rate of failure than GroupC (95% CI: 1.6,33.2).

### Discussion and Conclusion

Under anatomic loading, iPQSB plates with anterior column lag-screw fixation demonstrate increased stability in a synthetic bone transverse acetabular fracture model. Based on our data, we support additional evaluation of early weight bearing after transverse acetabular fracture fixation in patients with healthy bone when an anterior column screw-iPQSB plate construct is used.

Primary Presenter: Colton Sauer

Project Title: *Comparison of Rotational and Clinical Outcomes between Trochanteric Intramedullary Nails and Blade Plate Fixation for Femoral Derotation Osteotomies*

Primary Mentor: James Carollo, PM&R

Secondary Mentor(s): Jason Rhodes, Orthopedics

Thematic Area: Clinical Science

Abstract:

**Background**

The femoral derotation osteotomy (FDO) is used to correct femoral rotational deformities. Osteotomy fixation is achieved using blade plates (BP) or intramedullary nails (IMN). There is currently no literature directly comparing the outcomes for patients receiving these fixation methods for FDOs. This study aims to test for differences between the BP and IMN FDO fixation methods with respect to biomechanical and clinical outcomes.

**Methods**

Retrospective gait analysis data were collected on 89 subjects with cerebral palsy (CP) and other diagnoses (non-CP), receiving FDOs using BP or IMN fixation. Changes in gait analysis transverse plane kinematics at the pelvis, hip, and foot were recorded between pre- and post-operative gait analysis visits. Surgical and follow-up notes were also reviewed for single event multilevel surgeries (SEMLS), surgical time, total blood loss, length of hospital stay, time to weight bear and age at time of surgery. Subjects (N = 26) in these two groups were optimally matched using a validated statistical algorithm to minimize confounding effects of SEMLS and other relevant variables.

**Results**

There were no statistically significant differences ( $\hat{\alpha} = 0.05$ ) between the BP and IMN fixation methods with respect to rotational kinematics. There were no significant differences between the BP and IMN groups with respect to surgical outcomes except for time to weight bear, where those with IMN fixation were cleared for weight bearing as tolerated 11.9 days sooner than those with BP fixation ( $P = 0.031$ ).

**Conclusions**

IMNs have shorter time to weight bear while being comparable to BPs with respect to correction of rotational deformities. Based on the significant finding of reduced time to weight bear while using IMN fixation, this study suggests the use of IMN for isolated FDOs to correct femoral rotational deformities.

Primary Presenter: Alexander Schulick

Project Title: *A New Angle on Pancreatic Cancer: Can Preoperative Thrombelastography Predict Outcomes After Surgery?*

Primary Mentor: Marco Del Chiaro, Surgery

Thematic Area: Clinical Science

Abstract:

**Introduction**

150 years have passed since Trousseau initially described a relationship between cancer and coagulation. Recently, elevated thromboelastography (TEG) angle has been associated with adenocarcinoma of the pancreas. It remains unclear if angle correlates to disease recurrence after resection. We hypothesize that an elevated pre-operative TEG angle correlates with early disease recurrence and decreased disease-free survival.

**Methods**

Patients undergoing pancreatectomy had pre-operative blood drawn from 2016-2017. Medical records were reviewed to assess for early disease recurrence( $\leq 12$  post-operative months). Receiver Operating Characteristic(ROC) curves evaluated the performance(Area Under Curve, AUC) and derive the optimal cutoff for predicting early disease recurrence with TEG angle and CA19-9. Chi-square test contrasted patients with high/low angle (and CA19-9) to assess differences in early recurrence. Kaplan-Meier curves were generated to contrast disease-free survival from the operating room and overall survival between groups.

**Results**

61 patients with a median follow-up of 20 months were included. ROC curves identified TEG angle  $>43$  degrees(AUC=0.715) and CA19-9  $>120$ (AUC=0.629) as optimal cutoffs for early recurrence. For patients with adenocarcinoma, an elevated angle was associated with early recurrence(40%) compared to non-elevated(11%  $p=0.049$ ), however elevated CA19-9 was not significant (42% vs non-23%  $p=0.294$ ). Disease-free survival was decreased in patients with an elevated angle(figure,  $p=0.009$ ); overall survival was decreased as well (42% vs 81%  $p=0.004$ ).

**Conclusion**

Pre-operative elevation of TEG angle is associated early disease recurrence, decreased disease-free survival, and overall survival for patients undergoing pancreatectomy for adenocarcinoma. TEG may provide a better prognostic tool than CA19-9 to guide treatment plans for patients with pancreatic cancer.

Primary Presenter: Talia Scott

Project Title: *The Prevalence of the Female Athlete Triad in Adolescent Dancers*

Primary Mentor: Emily Sweeney, Sports Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

The Female Athlete Triad is a well-established syndrome in female athletes that involves abnormalities in energy availability, menstruation, and bone mineral density. Dance is an aesthetic activity that has historically emphasized leanness yet the data regarding prevalence of the triad in adolescent dancers is very limited. Our hypothesis is that the prevalence of the triad amongst pre-professional adolescent dancers is higher than previously reported rates seen in adolescent athletes and non-athletes. Adolescent dancers completed the Female Athlete Triad Screening Questionnaire and a 3-day food and exercise diary to assess for the triad. Our study was underpowered to establish prevalence; therefore we assessed our secondary outcomes and found that there were no significant differences between ballet dancers versus jazz/contemporary dancers in their percent estimated body weight or risk factors for the triad. There is still the potential that adolescent dancers are at higher risk of the triad than their peers and are not being screened adequately. As we were unable to establish the prevalence of the Female Athlete Triad, future studies should endeavor to do so.



Primary Presenter: Meha Semwal

Project Title: *Best practices to teach diversity and inclusion at U.S Medical Schools: a systematized review of the literature*

Primary Mentor: Rita Lee, Internal Medicine

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

#### BACKGROUND

The LCME (Liaison Committee on Medical Education) requires accredited schools of medicine to teach “cultural competency and disparities in medicine.” CUSOM (the Colorado University School of Medicine) meets this by “threading” lessons on culturally effective medicine throughout all four years of the undergraduate medical curriculum. The goal of this thread is: “to help medical students understand healthcare and disease differences based upon culture, ethnicity, gender, language and literacy, socioeconomic class, spirituality and religion, age, sexual orientation, and disability and to ensure that medical students develop knowledge, skills and behaviors with respect to the great diversity of the human condition.” While this goal is well-intentioned and aligns with national goals of multicultural medical education, it is not clear if the current pedagogy pursues this endeavor using evidence-based methods. Any further reform should be evidence-based, best practice pedagogy and strategies.

#### OBJECTIVES

(Problem Statement and Aims): What are the most effective ways for teaching diversity and inclusion curricula at medical schools, and other health professional schools? Our main goals are to: (1) compile a table of relevant articles that address the question: how do we teach students that health disparities are still a problem, and arm students with effective tools to practice culturally competent (humble) medicine? and (2) propose a new, “best practices” model “of both content and methodology” for teaching diversity & inclusion from expert, evidence-based recommendations. We will compare the current CUSOM curriculum to best practices to inform the post-LCME reform, using paradigms from other successful programs around the nation.

- Hypothesis 1. Effective educational strategies for diversity will require mixed methodology with repeated exposures.
- Hypothesis 2. The current CUSOM curriculum does not match current known best practices.

#### METHOD

We conducted a (1) systematized review (= “systematic search and review”) and (2) a critical review of the relevant literature to offer up best practices to institutions. We used a search matrix for PubMed. The search was made specific enough, so the researchers did not introduce too much bias with inclusion or exclusion of articles. The search term included concepts such as: medical school, diversity and inclusion, and cultural competency curricula.

#### RESULTS

The results are presented in an annotated bibliography. The systematized search of PubMed yielded 100 peer-reviewed articles. Articles were further sub-divided by relevancy. Our “core literature” contained 69 articles on U.S. M.D. programs. Our “peripheral” literature contained 31 articles (18 on non-M.D. programs and 13 articles on non-U.S. programs) that are only listed (without annotation) for

completeness at the end of the results section. The core of 69 articles were then further analyzed by theme, and coded into broader schemas: (1) the problem (19 articles), (2) the vision (29 articles), and (3) the solution, (21 articles). Each of these sub-themes, with corresponding articles, are discussed in great depth in an annotated list format.

## CONCLUSIONS

While cultural competency is well-intentioned nationally, and required by the LCME, it may not be the best model to teach health disparities €”cultural humility and critical consciousness are more updated models. The curricula cannot be solely didactic and requires a mixed-methodology and multiple exposures strategy; this can be done via small groups, PBL, electives, interactive role play, reflective writing, inter-clerkships, community-based education and/or service learning. The implicit institutional context is as important as the explicit lessons taught in the classroom €”resources need to move towards updating institutions with recruiting URM faculty, continuing medical education and incentivizes to build faculty allies, as well as multi-institution partnership to help standardized best practices pedagogy for diversity and inclusion.

Primary Presenter: Shannon Shaw

Project Title: *Frankenfeet: A Pathography on Medical Education from a Patient and Student*

Primary Mentor: Therese Jones, Bioethics and Humanities / Internal Medicine

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Graphic Medicine, the depicting of medical conditions in graphic novel or comic book form, is a relatively new concept for medical narrative. Patient narratives have been used and accepted as educational tools in the past, the use of illustration can bring a new experience to conveying living with medical conditions. A drawing or picture can depict emotion that may be difficult to describe in writing. The use of pictures means that there are aspects of the story that are shown rather than stated creating the need for interpretation on the part of the reader. Some professors have used this aspect of graphic medicine in medical schools to help teach their students empathy, better interpretation of facial expression and of body language. The process has also been studied as a way to help patients come to terms with their condition. It can be a therapeutic process to depict unpleasant, frustrating or embarrassing components of their condition in the more humorous vision of a cartoon. I aim to review literature in this area and discuss the benefits of graphic medicine as a narrative form as therapy and an educational tool for students and patients. Alongside this will be the discussion of the drawbacks of the medium, including the lack of qualitative and quantitative research, the stigma of comics, and the variability with which this particular form can be written with. Accompanying this paper will be my personal graphic medicine novel that will be written to depict my ongoing personal experience with chronic injury and surgery. I aim to provide an in-depth discussion of the positives and negatives of graphic medicine 's use in the healthcare process while contributing to the medium.

Primary Presenter: Angela Shimoda

Project Title: *Long-term visual outcomes following abusive head trauma with retinal hemorrhage*

Primary Mentor: Jasleen Singh, Ophthalmology

Thematic Area: Clinical Science

Abstract:

**Purpose**

To report the rates of vision loss and select ocular findings after abusive head trauma (AHT) with retinal hemorrhages at a single center.

**Methods**

The study cohort was identified by review of billing records for patients presenting simultaneously with retinal hemorrhages and abusive head trauma at the Children's Hospital of Colorado from October 2005 to April 2017. The following data were analyzed: retinal examination at initial admission and vision acuity, other pertinent eye findings, and eye management at follow-up visits. Patients with <1 month of follow up were excluded.

**Results**

Of 96 children, at last follow-up 46% had abnormal vision for the given age in at least one eye. Ocular findings included strabismus (43%), amblyopia (40%), optic disk pallor (13%), and cortical visual impairment (19%). For the 41 patients with strabismus, 20 (49%) required eye muscle surgery. Cortical visual impairment was almost three times higher in patients with strabismus compared with patients without strabismus ( $P = 0.023$ ) and almost 6 times higher in patients with optic disc pallor than in those without ( $P < 0.001$ ). Three patients (3%) required retinal surgery.

**Conclusions**

In our study cohort, there was a high rate of long-term vision impairment and ophthalmologic comorbidities in children with AHT and retinal hemorrhage.

Primary Presenter: Drake Sisneros

Project Title: *All the Cool Kids Get Vaccinated: Addressing Non-Vaccination in a Nursing Home*

Primary Mentor: Mark Deutchman, Family Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

**BACKGROUND**

A report was run to evaluate the influenza immunization status and the status of immunization education provided to residents at Union Printers Home (UPH), a skilled nursing facility. There were a number of residents that refused the influenza vaccine that were not provided education on the importance of the vaccine. The assumption was without education, individuals were not well-equipped to make an informed decision. Colorado 's nursing home influenza vaccination coverage is 75.9% for the 2016-2017 season. Influenza poses a serious threat to older adults. Adults older than 65 are generally more vulnerable to severe flu illness requiring hospitalizations; experiencing complications from the flu, including death. This is partly due to the decrease in T-cell function that occurs with aging, as well as certain long-term medical conditions that tend to plague this population. The CDC (Centers for Disease Control and Prevention) estimates that at least half of influenza-associated hospitalizations have occurred among people 65 years and older. Additionally, at least 70 percent of influenza-associated deaths have occurred in people 65 years and older. CDC recommends that everyone greater than 6 months of age get vaccinated against influenza every year (Medline Plus, 2019). Special emphasis should be placed on vaccinating residents at Union Printers Home, because there is a large percentage of patients that are at risk for serious flu illness.

**AIM STATEMENT**

The goal is to have 100% of non-vaccinated residents at Union Printers Home receive influenza immunization education, by December 2018.

**MEASURES**

The total influenza vaccination coverage was measured.

**CHANGE(S):**

Residents of Union Printers Home will be informed of the importance of the influenza vaccine and be provided the additional education to make an informed decision.

**PLAN**

The status of influenza vaccination will be gathered in a report generated by the electronic medical record. I will educate nonvaccinated residents about the importance of influenza vaccination. I will attempt to consent for vaccination after I provide education. I will then compare the vaccination coverage of the residents before and after educational counseling.

**HYPOTHESIS**

I predict that the vaccination coverage of nonvaccinated residents will improve with increased education.

DO

I generated a report using the electronic medical record, that listed the influenza immunization status of all the residents of Union Printers Home. I spoke to nonvaccinated residents who refused the vaccine and recorded their reasons. I educated residents about the importance of influenza vaccination, addressed residents' individual beliefs, and provided any evidence that supported or refuted their beliefs using information found on <https://www.cdc.gov/flu/about/qa/misconceptions.htm>. Subsequently, residents were asked if they wanted to receive the vaccination. A paired two-tailed t-test was utilized to observe for any reliable differences between vaccination coverage before and after the intervention.

## RESULTS

Before my intervention, 49 of 69 residents were vaccinated at Union Printers Home. This was a 71% vaccination coverage (just below the 2016-2017 Colorado's nursing home influenza coverage of 75%). Twenty residents were educated on influenza vaccination. A total of 9 patients out of 20 patients were consented and vaccinated after the intervention. This resulted in a 84% total vaccination coverage. A paired two-tailed t-test used to check the effectiveness of the educational intervention in improving vaccination coverage,  $t(68)=3.1$ ,  $p=0.0021$ , supports a significant increase in vaccination coverage found after the intervention (Post-Intervention mean = 84; Pre-intervention mean = 71.)

Primary Presenter: Darin Sisneros

Project Title: *Feed Aurora: Nutrition Education Effectiveness*

Primary Mentor: Lilian Diab, Children's Hospital Pediatrics

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Introduction

FEED Aurora is a nutrition-based pediatric program founded through an Innovations Award in 2016 by two first-year medical students. In recognizing a need for food resources and nutritional information in Aurora, FEED Aurora was designed to provide under-housed children with an opportunity to learn about food while eating nutritious meals. In continuing FEED Aurora programming, our leadership sought to understand the efficacy of our nutritional intervention within the Aurora, Colorado pediatric population.

Objectives

To determine if FEED Aurora 's nutritional interventions affect dietary and lifestyle choices in elementary school children.

Methods

A five-question survey was designed to be taken by the parent or legal guardian of children who participated in FEED Aurora programming during summer programming at the Colfax Community Network in 2017 and after-school programming at Crawford Elementary School during the 2017-2018 school year. Surveys printed in both English and Spanish were given to the children before and after our programming at both sites. Pre- and post-programming survey data were then collected and compared using unpaired t-tests to understand if FEED Aurora interventions resulted in any statistically significant difference in a child 's reported dietary habits.

Results

During the summer of 2017 at Colfax Community Network, 20 pre-programming surveys were collected. However, only 4 post-programming surveys were completed. During the 2017-2018 school year at Crawford Elementary, 9 pre-programming surveys were collected. However, only 4 post-programming surveys were completed. For Colfax Community Network, results indicate no statistical difference in reported consumption of soda per week (pre-survey mean 1.15, post-survey mean 1.0, p-value 0.6207), fruits (pre-survey mean 1.55, post-survey mean 1.5, p-value 0.9156), vegetables (pre-survey mean 1.35, post-survey mean 2.25, p-value 0.1685), or whole grains (pre-survey mean 2.05, post-survey mean 1.75, p-value 0.5686). Similarly, there was no statistical significance in willingness to try new foods (pre-survey mean 1.2, post-survey mean 1.5, p-value 0.5532). At Crawford Elementary School, there was no statistically significant difference in reported consumption per week of soda (pre-survey mean 0.67, post-survey mean 0.75, p-value = 0.7867), fruits (pre-survey mean 1.78, post-survey mean 1.75, p-value = 0.9659), vegetables (pre-survey mean 1.78, post-survey mean 2.0, p-value = 0.7251), or whole grains (pre-survey mean 1.78, post-survey mean 1.50, p-value = 0.6462). There was also no statistical significance in willingness to try new foods (pre-survey mean 1.78, post-survey mean 1.0, p-value = 0.2683).

## Conclusion

Many children within the city of Aurora experience significant food insecurity. FEED Aurora is a nutritional intervention that targets under-housed and minority youth within the Aurora community. Although nutrition interventions have been shown to have a lasting impact on pediatric populations, organizing sustainable nutrition interventions requires significant funding, consistent and reliable staff, and community partnerships. While FEED Aurora worked to establish these supports, our leadership team experienced difficulties in securing sustainable funding and volunteers. Consistent turnover in medical student volunteers and community-partner leadership provided additional barriers to consistent FEED Aurora programming. Gathering survey data from our targeted population also posed several challenges in achieving adequate sample sizes. While our study sought to better understand the efficacy of FEED Aurora programming and interventions, we were unable to gather sufficient survey data in order to answer these questions. Limitations were inherent in our study, including our survey design, the young age of participants, socioeconomic barriers to reliably return surveys, limited class size at both intervention sites, a transient population of children, consistent turnover of survey distributors, and lack of buy-in from the administrative staff at both sites. As FEED Aurora continues to work with Aurora youth on improving nutrition education and access to healthy meals, more work needs to be done in order to better understand the efficacy and long-term effects of FEED Aurora programming on the Aurora community.



Primary Presenter: Jessica Smith

Project Title: *Psychiatry Faculty's Attitudes, Beliefs, and Clinical Practices around Opioid Use Disorders at the University of Colorado*

Primary Mentor: Alexis Ritvo, Department of Psychiatry

Thematic Area: Public Health and Epidemiology

Abstract:

#### Background

The 2017 National Survey on Drug Use and Health performed by the Substance Abuse and Mental Health Services Administration (SAMHSA) reported that 8.5 million people had co-occurring mental health and substance use disorders (SUDs). Out of that 8.5 million people, 49% received no treatment and 8.3% received both mental health treatment and specific substance use treatment (SAMHSA, 2017). The purpose of this project is to create a survey for general psychiatry physician faculty in the University of Colorado 's Department of Psychiatry to assess attitudes, knowledge and barriers to treatment of opioid use disorders (OUDs) with buprenorphine maintenance treatment (BMT).

#### Methods

A 22-item online survey was created through Qualtrics and provided to general psychiatry physician faculty in February 2019. Responses were measured on a 5-point Likert scale where 5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = strongly disagree and 1 = disagree. The data was analyzed using chi-square tests by dividing responses into either the “agree” category (score  $\geq 4$ ) or the “disagree” category (score  $\leq 2$ ), depending on whether the question stem queried agreement or disagreement. Data was then presented to general psychiatry residents and faculty, and assessed for opportunities to improve the attitudes, knowledge and barriers to treatment of OUDs with buprenorphine in the University of Colorado 's Department of Psychiatry.

#### Results

Out of 320 email invitations sent to physician faculty requesting participation in our study, 79 responses were received for a response rate of 24.7% (n=79). Forty-five (57.0%) participants reported completing buprenorphine training, of whom 33 (73.3%) reported having prescribed buprenorphine and 19 (42.22%) stated they currently prescribe buprenorphine. Out of our list of fourteen suggested barriers, four barriers showed significantly different agreement level between participants who had completed training and those who had not:

- No supervision from experienced mentors (p=0.02)
- Do not want to attract patients with opioid addiction to my office (p=0.008)
- Worried about patients becoming addicted to buprenorphine (p=0.008)
- Lack of comfort with instructing patients on a home induction protocol (p=0.02).

97.8% and 91.2% of participants with and without buprenorphine training, respectively, agreed that opioid use disorder is a treatable illness, and 93.3% and 91.2% of participants with and without buprenorphine training agreed that BMT is an effective treatment for opioid use disorder.

## Conclusions

Our study shows that there are differences in perceived barriers and attitudes regarding BMT between those physician faculty who have obtained buprenorphine training and those who have not in the University of Colorado 's Department of Psychiatry. Those physician faculty who have not completed training are more likely to state negative attitudes towards and identify barriers to prescribing BMT to patients with OUDs.

Primary Presenter: Joshua Smith

Project Title: *High-dimensional analysis of post-splenectomy peripheral immune cell changes*

Primary Mentor: Martin McCarter, Surgical Oncology

Thematic Area: Clinical Science

Abstract:

**Objectives**

Characterize circulating immune cell populations in patients before and after elective splenectomy to determine if these changes are related to post-splenectomy survival outcomes.

**Methods**

We retrospectively collected clinical information from 95 patients undergoing elective splenectomy and compared it to 91 patients undergoing pancreaticoduodenectomy (Whipple procedure). We further analyzed peripheral blood from five patients in the splenectomy group, collected before and after surgery, using single-cell cytometry by time-of-flight mass spectroscopy (CyTOF). We compared pre- and post-splenectomy data to characterize both the major and minor immune cell populations in significantly greater detail.

**Results**

Compared to patients undergoing a Whipple procedure, splenectomized patients had significant and long-lasting elevated counts of lymphocytes, monocytes, and basophils. The CyTOF analysis demonstrated that the elevated lymphocytes primarily consisted of naïve CD4<sup>+</sup> T cells and a population of activated CD25<sup>+</sup>CD56<sup>+</sup>CD4<sup>+</sup> T cells, while the elevated monocyte counts were mainly mature, activated monocytes. We also observed a significant increase in the expression of the chemokine receptors CCR6 and CCR4 on several cellular populations.

**Discussion**

Taken together, these data indicate that significant immunological changes take place following splenectomy. While other groups have compared splenectomized patients to healthy controls, this study compared patients undergoing elective splenectomy to those undergoing a similar major abdominal surgery. The changes in CCR6 and CCR4 expression may be the result of changes in cytokine bias towards Th2 and Th17 cytokine production, and possibly contribute to the increased risk of post-splenectomy malignancies observed in other studies.

**Conclusion:**

Splenectomy results

Primary Presenter: Blake Snyder

Project Title: *The Pursuit of a Career in Global Health:*

*1. Risk Factors and Epidemiologic Predictors of Blood Stream Infections with New Delhi Metallo-b-lactamase (NDM-1) Producing Enterobacteriaceae*

*2. Accuracy of computer-assisted vertical cup-to-disk ratio grading f*

Primary Mentor: Jeremy Keenan, Ophthalmology

Secondary Mentor(s): Madiha Abdel-Maksoud

Thematic Area: Global Health

Abstract:

#### Background

Carbapenem-resistant Enterobacteriaceae conferred by New Delhi metallo-b-lactamase (NDM-1) resistance mechanism is endemic in India and Southeast Asia. An understanding of risk factors for NDM-1 infections is necessary to guide prevention strategies.

Methods: Our retrospective case-control study included patients admitted at Christian Medical College (CMC), Vellore between May 2010 and August 2014 with carbapenem-resistant *Klebsiella pneumoniae* blood stream infection (BSI). We compared NDM-1 producing strains to two control groups: BSI with other multidrug resistant (MDR) strains and BSI with pan-sensitive strains. Outcomes assessed included: 1) infection with any MDR strain compared to pan-sensitive; and, 2) infection with NDM-1 strain as compared to other MDR.

#### Results

Medical (OR 10.4) and neonatal (OR 0.7) ICU admission, central venous catheter placement (CVC, OR 7.4) predicted MDR BSI. Prior carbapenem use (OR 8.4) and CVC (OR 4.8) predicted acquisition of a NDM-1 strain.

#### Conclusions

CVC placement, prior carbapenem use, and ICU admission were significantly associated with BSI with NDM-1 producing and other MDR strains.

Purpose: Glaucoma screening can be performed by assessing the vertical-cup-to-disk ratio (VCDR) of the optic nerve head from fundus photography, but VCDR grading is inherently subjective. This study investigated whether computer software could improve the accuracy and repeatability of VCDR assessment.

#### Methods

In this cross-sectional diagnostic accuracy study, 5 ophthalmologists independently assessed the VCDR from a set of 200 optic disk images, with the median grade used as the reference standard for subsequent analyses. Eight non-ophthalmologists graded each image by two different methods: by visual inspection and with assistance from custom-made publically available software. Agreement with the reference standard grade was assessed for each method by calculating the intraclass correlation coefficient (ICC), and the sensitivity and specificity determined relative to a median ophthalmologist grade of  $\% \approx 0.7$ .

## Results

VCDR grades ranged from 0.1 to 0.9 for visual assessment and from 0.1 to 1.0 for software-assisted grading, with a median grade of 0.4 for each. Agreement between each of the 8 graders and the reference standard was higher for visual inspection (median ICC 0.65, interquartile range 0.57 to 0.82) than for software-assisted grading (median ICC 0.59, IQR 0.44 to 0.71);  $P=0.02$ , Wilcoxon signed-rank test). Visual inspection and software assistance had similar sensitivity and specificity for detecting glaucomatous cupping.

## Conclusion

The computer software used in this study did not improve the reproducibility or validity of VCDR grading from fundus photographs compared with simple visual inspection. More experience was correlated to higher agreement.

Trial Registration: Not Applicable

## Background

Verification of trachoma elimination requires monitoring after discontinuation of trachoma program activities, though such surveys are not commonly done. Methods: Conjunctival examinations and smartphone photography were performed on a random sample of pre-school children from 15 villages in a region of Burkina Faso thought to have eliminated trachoma.

## Results

No clinically active trachoma was detected by in-field or photographic evaluation. Smartphone images demonstrated high agreement with field grading (>99% concordance).

## Conclusions

Trachoma appears to have been eliminated from this area of Burkina Faso. Smartphone cameras may be a useful aid for monitoring in resource-limited settings. Visual impairment and blindness in the developing world are increasingly a result of non-communicable diseases that would benefit from early detection and treatment. However, the optimal methods and setting for a screening program, as well as the cost-effectiveness of eye disease screening in a developing country, have not been well characterized. To address this gap in knowledge, we instituted an eye disease screening program at both a general medical clinic and a diabetes clinic at Chiang Mai University Hospital in northern Thailand. Clinic patients 50 years and older who agree to participate will undergo visual acuity screening, intraocular pressure testing, and fundus photography, with referral to the ophthalmology clinic according to pre-specified criteria. We have outlined two specific aims in this research: first, to assess the sensitivity and specificity of different tests for detecting diabetic retinopathy, and second, to determine the incremental cost-effectiveness of screening in the diabetes clinic relative to the general medical clinic. Detection of asymptomatic eye disease through screening should lead to earlier treatment and less visual impairment, which should in turn improve the population's quality of life and mitigate the costs associated with visual impairment.

Primary Presenter: Subada Soti

Project Title: *Targeted family planning service expansion in a high risk population: A quality improvement intervention to increase access to family planning services for people with severe mental illness in an outpatient psychiatric clinic.*

Primary Mentor: Michelle Cleeves, Internal Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

#### Background

Patients with severe mental illness (SMI) have a higher risk of unintended pregnancies and poor pregnancy outcomes<sup>[i]</sup> (#\_edn1),<sup>[ii]</sup> (#\_edn2) compared to general population, yet are less likely to receive contraceptive services.<sup>[iii]</sup> (#\_edn3) Despite having frequent contact with psychiatric services, patients with SMI indicate that a separate family planning (FP) service at the mental health treatment facility would increase their engagement.<sup>[iv]</sup> (#\_edn4),<sup>[v]</sup> (#\_edn5),<sup>[vi]</sup> (#\_edn6) Thus, our objective was to expand FP services to women and men of childbearing age, who receive out-patient psychiatric care at the Mental Health Center of Denver (MHCD).

#### Methods

Denver Health (DH) and MHCD, both safety-net care settings, collaborate to provide co-located primary care clinic (PCC) within MHCD 's largest adult out-patient psychiatric clinic. We leveraged that close working relationship to integrate a monthly half-day FP clinic at the PCC at MHCD. Our services include options counseling and provision of all reversible contraceptive methods as well as referral to DH for permanent sterilization if desired. Expanding these services at a familiar location where clients already receive care reduces many barriers to access for the most vulnerable patients and provides an easy referral resource for psychiatrists, who are not able to address FP needs, yet care for and prescribe teratogenic medication to a high risk population. This service expansion was designed as a quality improvement (QI) project with interventions including collaborating with pharmacy and outreach to MHCD staff to generate patient interest in a walk-in clinic, offering services to MHCD employees to help improve understanding of the FP clinic, reviewing pharmacy work flow to identify patients in need, and expanding outreach to other MHCD service areas, especially their teen and young-adult outreach center.

#### Results

Using Slicer Dicer Software, we determined that there are 138 women of childbearing age at the PCC at MHCD, only 25 of whom have documented FP usage. Though we cannot access MHCD 's data on clients not enrolled at the DH PCC, we can estimate similar, if not worse, uptake in FP services for those patients not engaged in PCC. To date, we have offered 5 half-day FP clinics and seen 9 patients, providing 3 LARCs, and initiating OCPs for 2 patients.

#### Conclusions

Reaching patients with SMI and providing preventive services is incredibly challenging, even between institutions with an already close working relationship. Yet, poor prevalence of FP use in patients with SMI highlights the importance of such work. Through rapid implementation of services followed by evaluation and adjustments to our strategy, QI work enables us to continually improve to ideally provide full FP services to as many patients as possible moving forward.

Primary Presenter: Nicholas Stephanus

Project Title: *Attitudes Toward Vaccine Promotional Materials and Messaging*

Primary Mentor: Bethany Kwan, Department of Family Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

**Background**

Parental refusal of routine childhood vaccinations has increased in the United States, and reflects an increase in parental vaccine-hesitancy nationwide. The current state of vaccine-confidence has led to increased incidence of endemic outbreaks of vaccine preventable diseases (VPDs). Additionally, pediatricians' current interventions can be perceived as threatening and may backfire, further strengthening parental anti-vaccine attitudes and beliefs. New research is indicated to identify the conditions under which vaccine promotional materials (VPMs) lead to parental perceived threat. This objective is to assess the relationship between parental immunization values and perceived identity threat and receptivity to VPMs.

**Method**

The target sample consists of 200 parents at least 18 years of age who are first-time mothers of children less than 2 months-old or pregnant (at least 28 weeks gestation). The previously validated Immunization Values Survey consists of 20 items used to assess parental immunization values before participants view the VPMs. The Vaccine Information Sheet (VIS) from the Centers for Disease Control (CDC) and a novel "doctor's message" will comprise the VPMs. Previously validated Feelings, Felt-Arousal, and Epistemic Emotions scales are used for survey items assessing participants' level of perceived threat after viewing the VPMs. Additionally, four Likert-type items are employed to assess participants' receptivity to the VPMs.

**Progress to date**

A study protocol has been developed that includes an advertisement for participant recruitment, postcard consent, and eligibility screen for potential survey participants. Survey participants are currently being recruited from Denver metro-area primary care and pediatric clinics within the University of Colorado Hospital and Children's Hospital Colorado health systems. The protocol also includes the previously validated 20 item Immunization Values Survey used to measure parental immunization values. Also included in the protocol is the validated single item Feelings Scale used to measure participants' affect after reading the VPMs. Measures of affect and the validated 7-item Epistemic Emotions Scale used will indicate participants' level of perceived threat. The survey items and corresponding scales will be deployed on the web application known as REDCap, an electronic data capture tool.

**Future direction**

Preliminary research suggests that personal values differ significantly between parents with pro- versus anti-vaccine beliefs. While this project aims to assess the relationship between parental values and threat & receptivity to VPMs, evidence-based interventions are needed in primary care to combat shrinking vaccine-confidence and growing parental vaccine-hesitancy in the United States. Therefore,

new research is indicated to assess self-values-affirmation exercises as an intervention to improve parental receptivity to VPMs and reduce parental identity threat in a clinical setting.



Primary Presenter: Brittan Sutphin

Project Title: *Return to sport following lateral ankle ligament repair is under-reported: a systematic review*

Primary Mentor: Kenneth Hunt, Orthopaedics

Thematic Area: Clinical Science

Abstract:

Importance

Ankle sprains are the most commonly occurring musculoskeletal injury. Reconstruction of the lateral ligament complex is often required for athletes with recurrent instability, or high-grade acute sprains, in order to return to their preinjury level of sport.

Objective

The purpose of this systematic review was to evaluate the spectrum, prevalence and quality of evidence regarding return to sport timeline following lateral ligament surgery.

Evidence review: A search was conducted of Embase and Medline databases from the earliest possible entry to November 2016. Studies reporting a timeline regarding return to play (RTP) following lateral ankle ligament reconstruction were included in this review.

Findings

Of 3184 total articles, 20 articles evaluating 489 athletes met the criteria and were included for review. Thirteen of the 20 papers were used to calculate a weighted mean time to RTP of 4.7 months. Overall, both the frequency and quality of RTP criteria and reporting were very low.

Conclusions and relevance

The current review identifies a clear deficiency in the literature pertaining to consistent, meaningful postoperative RTP timeline following lateral ankle ligament repair. Published studies vary considerably in the metrics used for measuring patient-reported outcomes, and very few actually track them. Further studies on outcomes following ankle ligament repair should include clear and consistent metrics for return to sport and level of play. Standardised and reproducible criteria for reporting RTP for athletes will improve the utility and applicability of outcomes data as surgical and rehabilitative techniques continue to advance.

Level of evidence

Systematic review of level I -IV studies, level IV.

Primary Presenter: Kaitlin Sweeney

Project Title: *Establishment of a Community Partnership and Student-Run Free Clinic in Colorado Springs, CO*

Primary Mentor: Heather Cassidy, Internal Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

The University of Colorado School of Medicine opened a branch campus in Colorado Springs, CO, beginning in the Spring of 2015. Before this expansion into Colorado Springs, there was minimal community engagement from the medical school in Colorado Springs. Additionally, there are many under/ uninsured, undocumented, and underserved people living in Colorado Springs (1) indicating that there is a large need for affordable health care and safety net clinics. To give students in health care an opportunity to give back to their community and strengthen the safety net clinic system in Colorado Springs, we decided to establish a student-run free clinic. We did this by adding capacity to an established and underutilized free clinic in Colorado Springs and had our first primary care free clinic session in October, 2017. Since that time, we have had over 400 patient visits, incorporated pharmacy and premedical students into our practice, established a student-taught pre-clinic educational conference, and undertook several quality improvement and community outreach projects. Next steps in expanding and solidifying our clinic in the community will be to perfect clinic flow, increase capacity by increasing volunteer numbers and operating clinic days, and involving other specialties such as physical therapy and dental.

Primary Presenter: Kenji Tanaka

Project Title: *Humility and Responsibility: The Effects of Providing Care in a Second Language on the Training of Pediatric Residents*

Primary Mentor: Darcy Thompson, Pediatrics

Secondary Mentor(s): Raquel Hernandez

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

**Background**

There is a growing population of patients with Limited English Proficiency in the US and language barriers are known to complicate physician-patient interactions and affect quality of health care. Many physicians in-training are able to speak Spanish as a second language and choose to work in clinics serving primarily Spanish speaking patients. No study has been done to explore whether or not providing care in a second language has any effect on medical training.

**Objective**

To explore through interviews and mini focus groups the perceptions of pediatric residents on their experience in their continuity clinic providing direct patient care in a non-English language specifically as it relates to their training and development into competent generalist pediatricians.

**Design**

Qualitative Study using interviews and mini-focus groups  
Participants: Residents (n=13) in continuity clinics at 2 different pediatric residency programs: Johns Hopkins, UCSF, and the University of Arizona.  
Approach: Guided interviews that were transcribed, coded, and analyzed using thematic method.  
Results: Four recurrent themes emerged: 1) Language skills should never compromise patientcare 2) Residents working with LEP patients value addressing health care disparities and developing into more rounded physicians. 3) Learning to provide extra support to address limitations in the health care system 's ability to care for families with LEP. 4) Residents are confident that working with LEP patients has not affected their training.

**Conclusions**

Residents are generally satisfied with their experience providing care to patients/families with LEP. Their training is not negatively affected and is often enhanced by the exposure to health care disparities and a broader scope of medical issues. Residents recognize many of the gaps in care recognized in previous studies and address those in their daily practice with patients/families with LEP.

Primary Presenter: Margaret Tashjian

Project Title: *FEED Aurora: Nutritional Education Effectiveness*

Primary Mentor: Liliane Diab, Pediatric Nutrition

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Introduction

FEED Aurora is a nutrition-based pediatric program founded through an Innovations Award in 2016 by two first-year medical students. In recognizing a need for food resources and nutritional information in Aurora, FEED Aurora was designed to provide underhoused children with an opportunity to learn about food while eating nutritious meals. In continuing FEED Aurora programming, our leadership sought to understand the efficacy of our nutritional intervention within the Aurora, Colorado pediatric population.

Objectives

To determine if FEED Aurora 's nutritional interventions affect dietary and lifestyle choices in elementary school children.

Methods

A five-question survey was designed to be taken by the parent or legal guardian of children who participated in FEED Aurora programming during summer programming at the Colfax Community Network in 2017 and after-school programming at Crawford Elementary School during the 2017-2018 school year. Surveys printed in both English and Spanish were given to the children before and after our programming at both sites. Pre- and post-programming survey data were then collected and compared using unpaired t-tests to understand if FEED Aurora interventions resulted in any statistically significant difference in a child 's reported dietary habits.

Results

During the summer of 2017 at Colfax Community Network, 20 pre-programming surveys were collected. However, only 4 post-programming surveys were completed. During the 2017-2018 school year at Crawford Elementary, 9 pre-programming surveys were collected. However, only 4 post-programming surveys were completed. For Colfax Community Network, results indicate no statistical difference in reported consumption of soda per week (pre-survey mean 1.15, post-survey mean 1.0, p-value 0.6207), fruits (pre-survey mean 1.55, post-survey mean 1.5, p-value 0.9156), vegetables (pre-survey mean 1.35, post-survey mean 2.25, p-value 0.1685), or whole grains (pre-survey mean 2.05, post-survey mean 1.75, p-value 0.5686). Similarly, there was no statistical significance in willingness to try new foods (pre-survey mean 1.2, post-survey mean 1.5, p-value 0.5532). At Crawford Elementary School, there was no statistically significant difference in reported consumption per week of soda (pre-survey mean 0.67, post-survey mean 0.75, p-value = 0.7867), fruits (pre-survey mean 1.78, post-survey mean 1.75, p-value = 0.9659), vegetables (pre-survey mean 1.78, post-survey mean 2.0, p-value = 0.7251), or whole grains (pre-survey mean 1.78, post-survey mean 1.50, p-value = 0.6462). There was also no statistical significance in willingness to try new foods (pre-survey mean 1.78, post-survey mean 1.0, p-value = 0.2683).

## Conclusion

Many children within the city of Aurora experience significant food insecurity. FEED Aurora is a nutritional intervention that targets underhoused and minority youth within the Aurora community. Although nutrition interventions have been shown to have lasting impact within pediatric populations, organizing sustainable nutrition interventions requires significant funding, consistent and reliable staff, and community partnerships. While FEED Aurora worked to establish these supports, our leadership team experienced difficulties in securing sustainable funding and volunteers. Consistent turnover in medical student volunteers and community-partner leadership provided additional barriers to consistent FEED Aurora programming. Gathering survey data from our targeted population also posed several challenges in achieving adequate sample sizes. While our study sought to better understand the efficacy of FEED Aurora programming and interventions, we were unable to gather sufficient survey data in order to answer these questions. Limitations were inherent in our study, including our survey design, the young age of participants, socioeconomic barriers to reliably return surveys, limited class size at both intervention sites, a transient population of children, consistent turnover of survey distributors, and lack of buy-in from administrative staff at both sites. As FEED Aurora continues to work with Aurora youth on improving nutrition education and access to healthy meals, more work needs to be done in order to better understand the efficacy and long-term effects of FEED Aurora programming on the Aurora community.

Primary Presenter: Molly Thayer

Project Title: *Community Perspectives on the the Racial Disparity in Infant Mortality*

Primary Mentor: Janet Meredith, Department of Family Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

Background

The United States ' infant mortality rate is significantly higher among infants born to non-Hispanic Black women than infants born to women of other races, independent of educational attainment, marital status, or socioeconomic status. Addressing this disparity requires a multifaceted understanding of contributing factors and dynamics. Thus, we sought to explore community member perspectives on pregnancy, birth, and experiences in healthcare during the perinatal period.

Method

Researchers conducted focus groups with African American/Black women in the Denver community who had been pregnant previously and performed inductive thematic analysis looking at the interaction between race, perception of healthcare, and pregnancy/birthing experiences.

Results

Six focus groups (n=27) were completed. Participants reported that barriers to quality healthcare and emotional support during the perinatal time frame included being young during the time of pregnancy, having transportation difficulties, limited clinic hours, conflicting family beliefs, and being insured by Medicaid. Additionally, women perceived that healthcare professionals provide substandard care based on implicit bias. Participants felt that they lacked autonomy in decision-making related to their bodies or their babies. They also expressed an underlying mistrust in the healthcare system based on historic maltreatment of African American/Black people by medical institutions. Finally, the women described a need for more providers of color within healthcare systems.

Conclusions and Relevance

The African American/Black women in this study perceived discrimination from their healthcare providers based on race, age, and insurance status. They defined additional barriers to support including clinic locations and hours as well as differing family beliefs. To improve the relationships between African American women and their providers, participants expressed that racism and implicit bias must be recognized and addressed. Future directions based on this study include provider education on bias and healthcare disparities as well as community-based initiatives to provide support among African American/Black women during pregnancy and motherhood. It may also include system-level modifications to address bias, increase diversity within the healthcare field, and ultimately decrease the racial disparity in infant mortality.

Primary Presenter: Loree Thornton

Project Title: *Treatment of Lateral Epicondylitis*

Primary Mentor: Jamie Baker, Internal Medicine

Thematic Area: Clinical Science

Abstract:

Background

Previous meta-analyses have been conducted to compare outcomes of various treatment injections for lateral epicondylitis (LE), including corticosteroid injection (CSI) and autologous blood products such as autologous blood (AB) and platelet-rich plasma (PRP).

Purpose

To conduct a systematic review of overlapping meta-analyses comparing different injection treatments (CSI, AB, PRP) for LE to determine which meta-analyses provide the best available evidence.

Study Design: Systematic review; Level of evidence, 2.

Methods

A systematic review was performed by searching PubMed, Embase, and the Cochrane Library to locate meta-analyses that compared clinical outcomes of CSI, AB, and PRP for the treatment of LE. Search terms included "injection," "corticosteroid," "platelet-rich plasma," "autologous blood," "tennis elbow," "lateral epicondylitis," and "meta-analysis." Results were reviewed to determine study eligibility. Patient outcomes were extracted from these meta-analyses. Meta-analysis quality was assessed with the Oxman-Guyatt and Quality of Reporting of Meta-analyses (QUOROM) systems. The Jadad decision algorithm was then used to determine which meta-analyses provided the best level of evidence.

Results

Nine meta-analyses (two level 1 studies, seven level 2 studies) containing 8656 patients met the eligibility criteria. Seven meta-analyses found that autologous blood products such as AB and PRP significantly improved pain and elbow function in the intermediate term (12-26 weeks), while 4 studies found that CSI effectively relieved pain and improved elbow function in the short term (<12 weeks). The study by Arirachakaran et al in 2016 received the highest QUOROM and Oxman-Guyatt scores; therefore, this meta-analysis appears to have the highest level of evidence. In addition, this study was rated the highest-quality study in this systematic review according to the Jadad decision algorithm. Lower-quality meta-analyses indicated that dosage, number of injections, and differences in therapeutic duration between CSI and autologous blood products may be essential factors in determining the appropriate treatment injection protocol for LE.

Conclusion

The current best available evidence suggests that CSI improves functional outcomes and pain relief in the short term, while AB and PRP are the most effective treatments in the intermediate term.

Primary Presenter: Jon Alexander Torres

Project Title: *A Survey of Patient Perceptions and Preferences for Glaucoma Treatment with Intravitreal Injections*

Primary Mentor: Jeffrey SooHoo, Ophthalmology

Thematic Area: Clinical Science

Abstract:

**Purpose**

To investigate patient perceptions and preferences towards the use of intravitreal injection (IVI) for the treatment of glaucoma.

**Design:** This was a cross-sectional study of patients seen at the University of Colorado Health Eye Center.

**Participants**

Patients carried a diagnosis of glaucoma, currently or previously received topical medication drops, and have previously received an IVI for a different eye condition.

**Methods:** Participants were surveyed by telephone using a 10-item questionnaire. Preferences regarding glaucoma treatment modalities, specifically a theoretical choice between topical and IVI treatment options, were recorded.

**Main Outcome Measures**

Preferences towards IVI compared to topical drops in two different hypothetical scenarios, one where both are equally efficacious, and another where IVI is more efficacious. Secondary outcomes included preferred interval between injections.

**Results**

Fifty patients completed the survey. The mean age was 65 years (range 16 to 95). Patients were using an average of 1.6 glaucoma medications per day (range 1 to 4). Seventy-four percent of patients (n = 37) said they would prefer topical medication if equal in efficacy to monthly IVI. In a hypothetical scenario in which a monthly IVI was more effective than topical medication, 76% (n = 38) said they would then prefer injection. Additionally, injection became more preferable as the hypothetical dosing interval changed. Assuming equivalent efficacy, 46% of patients preferred injection if only required every 2 months, 62% if every 3 months, and 82% if injection was only required every 6 months. The main reasons cited for preferring topical medications were fear of pain, fear of the procedure, and the inconvenience of more frequent clinic appointments to receive treatment.

**Conclusion**

Patients are open to alternative methods of drug delivery, and their willingness to undergo more invasive treatments, like IVI, for glaucoma rises with a longer theoretical duration between treatments.



Primary Presenter: Karlie Urbach

Project Title: *The Role Of a One Health Interdisciplinary Curriculum Between Medical and Veterinary Students*

Primary Mentor: Roberto Silva, Family Medicine

Secondary Mentor(s): Mark Deutchman

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Animals and humans share susceptibility to numerous diseases, allowing for animals to serve as a warning sign of potential human illness. The term 'One Health' comes from the idea that the health of animals and humans are essentially 'one' and that there should never have been a separation between the two. Nowadays, the goal of One Health is to encourage collaborative interdisciplinary efforts to achieve the best health outcome for humans, animals, and the environment. Our goals in this project, through the collaborative efforts between students of the University of Colorado School of Medicine (CUSOM) and the University of Colorado Physician Assistant Program (UCPAP) with Colorado State University College of Doctor of Veterinary Medicine students (CSUDVM), is to provide a more meaningful educational experience for students and patients than intra-professional education alone by identifying the connections between human and animal health. Our methods include organizing conferences for medical and veterinary students, hosting events for joint learning, and evaluating the benefits of a One Health model of interprofessional education as reported by the students themselves to improve the rural track curriculum.

Primary Presenter: Katie Van Deventer

Project Title: *The Diagnostic and Prognostic Utility of Dual-Task Tandem Gait for Pediatric Concussion*

Primary Mentor: David Howell, Sports Medicine Center, Children 's Hospital Colorado

Thematic Area: Clinical Science

Abstract:

Background

Tandem gait performance is part of the Sports Concussion Assessment Tool (SCAT), but its diagnostic and prognostic value has not been fully assessed in pediatric concussion.

Purposes

To determine the diagnostic and prognostic value of single-task and dual task tandem gait by comparing performance of subjects with concussion relative to controls, as well as subjects who developed Persistent Post Concussion Symptoms (PPCS) and those who did not (No PPCS).

Methods

Subjects seen within 21 days of concussion and uninjured controls completed a single/dual-task tandem gait test battery and modified Balance Error Scoring System (mBESS) test. During the tandem gait test, subjects walked in a heel-toe manner along a 3m strip of fabric down and back as fast as possible. During dual-task trials, they completed a concurrent cognitive task. Outcomes included tandem gait time to completion, cognitive accuracy, and mBESS errors. Subjects with concussion were followed until symptom resolution, and sub-grouped into those who developed PPCS (>28 d time to symptom resolution) vs. No PPCS.

Results

We evaluated 29 subjects with concussion who developed PPCS (mean age=15 ±2 years; 62% female; tested 12 ±6 days post-injury), 58 subjects with concussion who did not develop PPCS (mean age=14 ±3 years; 36% female; tested 8 ±5 days post-injury), and 58 controls (mean age= 16 ±1 years; 42% female). Subjects with concussion performed significantly worse than healthy controls on single-task tandem gait (24.4 ±12.6 vs. 14.9 ±3.6 s; p<0.001; area under curve [AUC]=0.85), dual-task tandem gait (33.3 ±14.9 vs. 20.6 ±7.1 s; p<0.001; AUC=0.84), dual-task cognitive accuracy (82.1 ±12.5 vs. 89.1 ±18.9 %; p=0.01; AUC=0.61), and mBESS (6.5 ±4.9 vs. 3.8 ±3.4 errors; p=0.001; AUC=0.68). The PPCS sub-group performed dual-task tandem gait significantly slower than the No PPCS group (38.8 ±17.7 vs. 30.6 ±12.7 s; p=0.016; odds ratio=1.04), but PPCS and No PPCS groups were not significantly different on other measures.

Conclusions

Pediatric patients with concussion have impaired performance on balance and gait measures compared to healthy controls. Dual-task tandem gait test specifically showed diagnostic value for pediatric concussion and prognostic value in differentiating subjects who developed PPCS compared to those who did not.

Primary Presenter: Kaitlin VanderKolk

Project Title: *An Evaluation of the Current Curricula Regarding Reproductive Health Topics and Methods of Family Planning at United States Medical Schools*

Primary Mentor: Wendy Madigosky, Family Medicine

Secondary Mentor(s): Dr. Marguerite Duane, Georgetown University

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Knowledge and competency in the topics of reproductive health and family planning are important for the full-spectrum family physician. Given the high rates of unintended pregnancy, increasing rates of infertility and other gynecologic conditions, it is important for medical students, many of whom will become primary care physicians, to receive good foundational knowledge of reproductive health topics. The objective of this research project was to investigate the current curricula at US medical schools to determine the breadth and extent of education that medical students receive in reproductive health. Medical students and faculty at 20 US medical schools provided reproductive health curriculum content including syllabi, PowerPoint lectures, and official class handouts that were available to all students. From these, we counted the number of mentions of approximately 70 reproductive health-related terms. Major findings included an expectedly large emphasis on contraception, especially pharmacologic methods such as oral contraceptives and LARCs, with limited mentions of strategies to deal with infertility or reproductive health counseling. We hope that this data will help to show opportunities for broadening reproductive health education in medical school so that future primary care physicians are prepared to discuss the full range of reproductive options for their patients.

Primary Presenter: Alexander Vasconcellos

Project Title: *Use of a Simple Survey to Elicit Predictors of Maternal Complications in Rural Uganda*

Primary Mentor: Madiha Abdel-Maksoud, Epidemiology

Thematic Area: Global Health

Abstract:

Background

Maternal morbidity and mortality remains a major issue in Uganda. This study looks at Mpigi Health Center IV (MHCIV), a community based referral center serving a large catchment area.

Objectives

To use a survey to study socioeconomic and psychosocial factors and their correlation with maternal outcomes in rural Uganda at MHCIV.

Methods

A survey was developed and administered a survey to 147 women who delivered at the health center from June 12 to July 12 2017. It was administered in-person via interpreters when needed, and included 33 questions (maternal sociodemographic factors, prenatal conditions and care, mode of delivery and maternal complications). The outcome variable, maternal complications, was a composite variable including: miscarriage, fetal death, pre-eclampsia, prolonged labor, uterine rupture, post-partum hemorrhage and puerperal sepsis. Descriptive statistics were used to summarize the data, and multivariable logistic regression was used to examine the independent associations between the above-mentioned factors and maternal complications.

Findings

The average age of participants was 26.4 years. 60.5% of participants reported taking iron, 62% reported taking folic acid, and 56.5% reported taking sulfadoxine-pyramethamine for malarial infection or prevention of infection during pregnancy. Analysis revealed that pregnant women who did not take these three medicines were 5.472 times more likely to have maternal complications than those who took them.

Conclusions

In this study, the absence of prenatal medications during pregnancy was associated with increased risk of maternal complications. These medicines are prescribed by the prenatal clinic at MHCIV, and the intake of these could be an indicator of compliance with prenatal care in general. Therefore, increasing awareness about the importance of prenatal care, including the intake of supplements and antimalarials, in addition to ensuring the availability of these compounds is critical to reduce the burden of maternal complications in Mpigi and other high malaria burden regions.

Primary Presenter: Andrew Vines

Project Title: *Lack of Prenatal Vitamins and Anti-malarial Medications during Pregnancy is Associated with Maternal Complications in Rural Uganda*

Primary Mentor: Madiha Abdel-Maksoud, Colorado School of Public Health – Epidemiology Global Health Track CUSOM

Thematic Area: Global Health

Abstract:

#### Background

Maternal morbidity and mortality remains a major issue in Uganda. This study looks at Mpigi Health Center IV (MHCIV), a community based referral center serving a large catchment area.

#### Objectives

To use a survey to study socioeconomic and psychosocial factors and their correlation with maternal outcomes in rural Uganda at MHCIV.

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#### Conclusions

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Primary Presenter: Eric Viquez

Project Title: *Test Characteristics of Clinician-Performed Ultrasound for Deep Vein Thrombosis of the Lower Extremity*

Primary Mentor: Anna Maw, internal medicine

Thematic Area: Clinical Science

Abstract:

Background

Radiology-performed duplex ultrasonography is the current standard of practice in diagnosing deep vein thrombosis in the lower extremities (LEDVT). This method is highly sensitive and specific but can be time-consuming. Clinician-performed compression ultrasonography (CUS) allows providers to interpret results in real-time, leading to expedition of care. The reliability of point-of-care compression ultrasound is uncertain. The aim of this systematic review and meta-analysis was to reliably assess and compare the diagnostic performance, and critically evaluate the pooled test characteristics of point-of-care CUS in the diagnosis of LEDVT.

Methods

The MEDLINE, Embase, and Cochrane databases (up to October 2019) were searched systematically for the relevant studies. Study inclusion criteria were a prospective adult cohort presenting in any clinical setting with signs and symptoms of LEDVT who were evaluated with point-of-care CUS and had a reference standard of formal radiology department or vascular laboratory ultrasound or venography (both contrast and CT). The studies were independently assessed by two reviewers for inclusion criteria, and disagreements were resolved with discussion. Results were reported according to the Cochrane Handbook for Systematic Reviews of Diagnostic Test Accuracy and the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines. Two authors independently extracted data and used a modified QUADAS-2 tool to assess risk of bias. Hierarchical summary receiver operating characteristic modeling was used to determine the pooled sensitivity and specificity of point-of-care CUS.

Results

The literature search yielded 1367 nonduplicate titles that were screened, of which 43 articles (3.14%) underwent full-text review. 29 studies met the inclusion criteria, representing a total of 5871 patients. Pooled estimates for point-of-care CUS were 0.925 for sensitivity [CI 0.875-0.956] and 0.963 for specificity [CI 0.942-0.977].

Conclusion

Point-of-care compression ultrasound can reliably and accurately diagnose LEDVT at the bedside.

Primary Presenter: Miles Viseur

Project Title: *Integrating Group Psychological Care For Underserved Patients With Type II Diabetes At A Student-Run Free Clinic*

Primary Mentor: Bethany Kwan, Family Medicine

Thematic Area: Clinical Science

Abstract:

Diabetes is one of the most prevalent chronic health diseases in the United States, affecting approximately one out of every ten Americans as of 2017 and costing up to 20% of current healthcare spending. It is a very stressful disease to manage as patients are required to monitor diet, physical activity, medications, blood sugar levels, and insulin injections. As a result, many patients with diabetes experience “diabetes distress” - the sense of being overwhelmed by the emotional, regimen, health care and interpersonal burden of managing the disease. Diabetes distress, which is distinct from a comorbid clinical diagnosis of depression or anxiety, is positively related to the hemoglobin A1c (HbA1c) and is measured using the standardized Diabetes Distress Scale (DDS-17). Addressing diabetes distress is an important aspect of care to underserved patients with diabetes as they are more likely to experience psychosocial stressors than the general population. The DDS-17 is a useful clinical tool to help identify patients with poorly controlled diabetes that would benefit from psychosocial care in addition to optimizing pharmacologic therapy. The goal of this quality improvement project was to first educate healthcare volunteers at a local student-run clinic about diabetes distress in order to improve general understanding of the psychosocial stressors in patients with poorly managed type II diabetes. Due to unforeseen obstacles with patient recruitment at the DAWN clinic, corollary data was then adopted and analyzed from the Invested in Diabetes Study Protocol, a cluster randomized pragmatic trial involving approximately 1440 adult patients in the local Denver metro area, to determine if group diabetes education visits in both Federally Qualified Health Centers (FQHC) and non-FQHC community practices significantly reduced DDS scale scores and other measures of psychological stress. Additional subgroup analyses were performed to determine if the DDS scores of patients with type II diabetes at local FQHCs correlated with other scores which measured motivation, confidence, health literacy, and food availability. It was hypothesized that:

- Group diabetes visits would reduce diabetes distress and the psychological burden of living with diabetes in both patients treated at FQHCs and non-FQHC practices.
- Patients with type II diabetes being treated at an FQHC would have higher DDS scale scores than those being treated at non-FQHC practices,
- Patient demographics between local FQHCs in the Denver area and the DAWN clinic would be similar, and
- There would be a negative correlation between diabetes distress in patients at local FQHCs and their motivation, confidence, health literacy, and food availability scores.

Initial analysis from the Invested in Diabetes Study Protocol demonstrate that these hypotheses hold true. Integrated group diabetes visits with psychosocial care should be adopted at the DAWN clinic, a student-run free clinic in Aurora, Colorado. Further improvements to better integrate psychosocial care and address diabetes distress in clinics treating underserved populations is warranted.

Primary Presenter: Jessica Vo

Project Title: *A Quality Improvement Project: Introduction of Procalcitonin As A Guide For Antibiotic Use at University of Colorado Hospital*

Primary Mentor: Caitlin Dietsche, Hospital Medicine/Internal Medicine

Thematic Area: Clinical Science

Abstract:

#### BACKGROUND

Current literature supports the use of respiratory polymerase chain reaction (R-PCR) and serum procalcitonin (S-PCT) as tools to guide antibiotic therapy in community acquired pneumonia (CAP) [4, 5, 6]. However, in 2017 this practice was not in place at the University of Colorado Hospital (UCH).

**PURPOSE AND OBJECTIVES:** The aim of this quality improvement project was to reduce unnecessary antibiotic use by 30% by December 2017 at UCH through promoting the use of R-PCR and S-PCT in the diagnosis of viral CAP and as a guide for antibiotic treatment utilizing the Model for Improvement through Plan, Do, Study, Act (PDSA) cycles.

#### METHODS

We performed a pre-intervention survey to evaluate the knowledge and observe practice patterns of University of Colorado Internal Medicine residents regarding the use of R-PCR and S-PCT in the diagnosis and treatment of CAP. After discovering variability in both the knowledge and utilization of these tests, we decided to deliver 10-minute educational PowerPoint presentations to teach residents at four teaching sites (UCH, Denver Health, the Denver 's Veterans Affairs (VA) Medical Center, and Presbyterian St. Luke 's Medical Center) about how and when to use R-PCR and S-PCT, including when to discontinue antibiotics. A post-presentation survey was distributed to assess the effect of the educational presentations. In addition to an education intervention, we assessed system barriers at UCH for utilization of S-PCT by developing a process map and by speaking to key stakeholders.

#### RESULTS

Post-survey of Internal Medicine residents at the University of Colorado showed a trend towards increased confidence in how to use and interpret procalcitonin and how to safely continue or discontinue antibiotics following the educational intervention. Data review at UCH found that monthly procalcitonin orders had increased by a factor of 5, demonstrating the effect of simply having procalcitonin in-house paired with our educational intervention. By meeting key stakeholders at UCH and holding educational presentations, the team raised awareness of the need for a timely, in-house S-PCT and its importance as a tool to guide antibiotic therapy and S-PCT was able to be ordered in-house at UCH by the end of 2017.

#### CONCLUSION

The major barrier to the widespread utilization of S-PCT at UCH was the lack of the ability for an in-house lab. Utilizing the Model for Improvement through PDSA cycles is an effective way to generate and encourage change in health systems, as seen by the acquisition of S-PCT in-house and increased resident confidence in utilizing, interpreting, and integrating S-PCT into clinical practice following the PDSA cycle.



Primary Presenter: Nemanja Vukovic

Project Title: *Engaging Teens In Weight Management Conversations*

Primary Mentor: Janet Meredith, Department of Family Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

**Background & Objectives**

Approximately 1 in 5 teenagers in the United States are obese, and rates of adolescent obesity have quadrupled since 1980 with projections indicating continued rise. Adolescent obesity is associated with significant physical and psychosocial comorbidity. However, clinicians often fail to motivate teenagers to lose weight. We sought to investigate potential causes and solutions for this failure by evaluating clinic-based communication strategies.

**Methodology**

Mixed methods were used to evaluate patient and provider perspectives surrounding weight-based communication. Standardized focus group interviews with teenagers from Aurora, Colorado high schools were conducted. Focus groups were audio-recorded, transcribed, and qualitatively analyzed using open coding by three separate coders. Surveys were distributed to healthcare providers across Colorado via paper and electronic format. Eligible providers were clinicians in family medicine, pediatrics, and behavioral health who counseled teenagers. Physician survey responses were analyzed by summary statistics and open coding.

**Results**

Three gender-separated focus groups, each with 8-10 participants, were completed (n = 47). Five themes arose: (1) know the teen before discussing weight; (2) avoid using Body Mass Index (BMI); (3) elucidate the teen 's motivations; (4) provide personalized goals; (5) include frequent follow-up and encouragement. 170 provider survey results were collected, revealing that practitioners were comfortable initiating conversations, but most used BMI to open discussions, felt ineffective in promoting change, and saw a need to improve via adopting teen-approved strategies.

**Conclusions**

Teen-approved methodologies for updating providers on weight management counseling should be developed, tested, and implemented if successful.

Primary Presenter: Carson Walker

Project Title: *Clot activators do not expedite the time to predict massive transfusion in trauma patients analyzed with tissue plasminogen activator thromboelastography*

Primary Mentor: Hunter Moore, Surgery

Thematic Area: Clinical Science

Abstract:

#### BACKGROUND

Trauma patients with hypersensitivity to tissue plasminogen activator mediated fibrinolysis quantified by tissue plasminogen activator thromboelastography are at increased risk of massive transfusion. The tissue plasminogen activator thromboelastography assay has been tested in trauma patients using native thromboelastography with no exogenous activator. We hypothesize that adding an activator will expedite the time to results.

#### METHODS

Healthy whole blood was assayed with and without exogenous plasmin, which acts to deplete inhibitors of fibrinolysis, mimicking trauma blood. Samples were assessed using native, kaolin, and rapid thromboelastography with and without tissue plasminogen activator. The tissue plasminogen activator thromboelastography indices of time to maximum amplitude and lysis at 30 minutes were contrasted between healthy blood with and without plasmin using the three different activators. The activators were then used with a tissue plasminogen activator thromboelastography in 100 trauma patients to assess performance in predicting massive transfusion.

#### RESULTS

In healthy blood, regardless of activator, lysis at 30 minutes did not increase with plasmin alone, but did increase with tissue plasminogen activator ( $P = .012$ ). Adding tissue plasminogen activator and plasmin increased lysis at 30 minutes ( $P = .036$ ). Time to maximum amplitude was reduced with tissue plasminogen activator and plasmin compared with tissue plasminogen activator alone ( $P = .012$ ). Activated thromboelastographies had increased lysis at 30 minutes ( $P = .002$ ), but no difference in time to maximum amplitude compared with native thromboelastographies. In trauma patients, native tissue plasminogen activator thromboelastography had greater performance in predicting massive transfusion than activated tissue plasminogen activator thromboelastographies with no difference in time to maximum amplitude.

#### CONCLUSION

Adding an activator to tissue plasminogen activator thromboelastography does not expedite time to maximum amplitude in healthy blood depleted of fibrinolysis inhibitors. Activated tissue plasminogen activator thromboelastographies are inferior to native tissue plasminogen activator thromboelastography for predicting massive transfusion and do not reduce the time to results.

Primary Presenter: Catherine Waymel

Project Title: *Searching for the Antigen: A Case of Recurring Hypoxia*

Primary Mentor: Juan Lessing, Internal Medicine

Thematic Area: Clinical Science

Abstract:

#### BACKGROUND

Hypersensitivity pneumonitis (HP), also known as extrinsic allergic alveolitis, is an immune reaction to inhaled antigens that lead to inflammation of the lung parenchyma.

We present a case of HP that resulted from *Aureobasidium pullulans* in a case of presumed humidifier lung.

#### CASE PRESENTATION

An 80-year-old man presented with progressive shortness of breath and a productive cough. In the weeks prior to admission he had been hospitalized with presumed viral pneumonia, which temporarily improved with a 12-day steroid taper. The patient was admitted to the Intensive Care Unit (ICU) with profound dyspnea and required up to 12 LPM of oxygen and heated high flow to keep oxygen saturation above 90%. Physical examination revealed a temperature of 37.5o C, pulse of 91, respirations of 18, bilaterally diminished breath sounds and bibasilar crackles. A Computed Tomography Pulmonary Embolism (CTPE) demonstrated diffuse ground glass opacities and evidence of fibrosing interstitial lung disease (ILD). Given the above and a leukocytosis of 14.3 x10<sup>9</sup> cells/L, broad spectrum antibiotics were initiated for presumptive hospital acquired pneumonia. After 24 hours without significant clinical improvement, high dose intravenous steroids were initiated, following which his oxygen requirement began to downtrend. In the setting of his clinical presentation, imaging with evidence of ILD, and history of improvement with steroids, a hypersensitivity pneumonitis panel was sent and resulted positive for *Aureobasidium pullulans* antibodies. Upon further discussion, the patient revealed six months of recurrent “black mold” growth in his home humidifier despite repeated cleaning. The patient continued to improve with steroids, and was weaned down to 6 LPM of oxygen by discharge. Discharge planning included a follow up with pulmonology, who was to determine the steroid course.

#### CONCLUSIONS

Without diagnosis, management, and antigen removal, HP can lead to irreversible pulmonary fibrosis and lung transplantation. HP should be considered, and a thorough exposure history taken, when the disease course does not match the presumed diagnosis, or is refractory to management of the presumed diagnosis. Discovery of an antigen is of the utmost importance, as it is independently associated with improved survival in HP (Magee).

Primary Presenter: Jonathan Wehrend

Project Title: *Risk Factors For Mortality In Patients With Blunt Mechanism Aortic Trauma At UCH: UC Denver, Memorial Hospital Colorado Springs, Medical Center of The Rockies*

Primary Mentor: Lisa Ferrigno, Surgery

Thematic Area: Clinical Science

Abstract:

**Purpose of Study**

To describe the population affected by blunt aortic injury in Colorado and answer the question: What mechanistic, temporal and clinical factors are associated with mortality in BAI for patients in the UCHealth hospital system?

**Methods Used**

The study sites are University of Colorado Hospital, Memorial Hospital and Medical Center of the Rockies. Subjects  $\geq 18$  at time of injury, identified by ICD-9 were gathered by chart review for 1/1/06-9/11/17. Variables for demographics, injury and treatment were collected. Data were stored in RedCap and statistics performed with SPSS. Descriptive statistics, chi-square and ANOVA were performed as appropriate for variables. Binomial logistic regression was performed to determine the effect of multiple concurrent variables on mortality.

**Summary of Results**

Subject (N=65) mechanisms of injury were motor vehicle collisions 60%, motorcycle collision 16.9%, motor vehicle vs pedestrian 12.3%, falls 7.7%, other 3.1%. 50.8% of patients presented with GCS $\leq$ 8. 35.4% were transfer patients.  $\chi^2$  showed no significant difference in mortality for airbag deployment or seat belt use ( $\chi^2(1,39)=.009$ ,  $p=.925$  and  $\chi^2(1,39)=.022$ ,  $p=.882$ ). ANOVA showed subject mortality was not dependent on time to first medical care ( $F(32,17)=1.509$ ,  $p=.186$ ,  $\hat{\eta}^2=.74$ ) and not dependent on time to study hospital ( $F(39,14)=2.092$ ,  $p=.069$ ,  $\hat{\eta}^2=.854$ ). Binary logistic regression indicates that RTS is trending towards a significant predictor of mortality ( $\chi^2(12,54)=.009$ ,  $p<.05$ ). Other predictors of mortality ISS, TRISS, mechanism, transfer status, GCS, race and sex are not significant in the current model. RTS was significant at the 5% level (Wald=4.937,  $p=.026$ ). The odds ratio for RTS was .485 (95% CI .257-.918). The model correctly predicted 90.9% of cases of no mortality and 81% of cases of mortality (87% correct overall).

**Conclusions**

The data is fairly representative of Colorado as only UCHealth hospitals treat BAI, but the sample size is small as it is a rare injury. Data is still being collected for some fields and autopsy reports could provide additional subjects and data for certain subjects. The current regression model predicts mortality 87% correctly but further adjustment will be done to predict mortality more accurately and without a burdensome number of variables.

Primary Presenter: Lindsay Welton

Project Title: *Women's preferences for sexual health support following gynecologic and breast cancer. A qualitative survey and art exhibit.*

Primary Mentor: Saketh Guntupalli, Division of Gynecologic Oncology at the University of Colorado School of Medicine at Denver

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Background

Women report distress over relationships, body image and sexual function after cancer; those under 50 years old have a 3-times greater risk of sexual dysfunction following treatment. Survivors desire integrated and multifaceted interventions to maintain optimal sexual health.

Methods

We employed a mixed-method (concurrent nested) design to identify women 's preferences for sexual health support after gynecologic and breast cancer diagnosis. Women 18-50 years old were recruited at a national conference for young survivors and local breast/gynecologic clinics. Qualitative and quantitative assessments identified sexual health factors and support needs most prevalent. Summary statistics and theme analysis using grounded theory was conducted.

Results

Participants included 128 women (mean diagnosis age 35.6) and were: married (71%), breast cancer (46%), mastectomy (40%), hysterectomy (30%), chemotherapy (81%), radiation (51%) and completed treatment (67%). Nearly 1/3 of women reported their relationship worsening, 97% contribute it to less sexual activity; 71% were unsatisfied with their sexual relationship compared to before diagnosis. Women (77%) feel their oncologist should discuss sexual health and 74% prefer information prior to treatment. When asked to identify resources 82% desired helpful products/strategies; other desired resources include: written education (65%), medications/lubricants (68%), personal counseling (37%), sex therapist (41%) and local/web-based support groups (36%). When asked to describe their experience with sexual health women reported the following themes: supportive partners, sexual health status, guilt, stolen identity, loss of desire, isolation, treatment side effects, menopause, vaginal changes, maintaining relationships, coping mechanisms, fertility, self-image, grief, intimacy, and desire for oncologist support.

Conclusions

Sexual health support after diagnosis is an unmet need that can be integrated into treatment to greatly improve the quality of life for survivors. Women desire their oncologist to provide information before treatment and through survivorship on products/strategies, education, and medications/lubricants to maintain sexual function. Young women do not desire social support resources.

Primary Presenter: Zachary Wuthrich

Project Title: *Analysis of Stress Riser Effects of the Posterior Metaglene Screw in a Reverse Total Shoulder Replacement*

Primary Mentor: Vikas Patel, MD, Orthopedics

Thematic Area: Basic Biomedical Science

Abstract:

Some patients with reverse total shoulder arthroplasties are developing postoperative acromial or scapular spine fractures. It is hypothesized that the posterior metaglene screw acts as a stress-riser, potentially leading to failure, and that this effect varies with varying trajectory of that screw through the spinoglenoid notch. A finite element model of a shoulder implanted with a reverse total shoulder replacement was built and validated with results from other similar models. This model demonstrates the stress-riser effects of the posterior metaglene screw when placed into the base of the scapular spine, as well as fluctuations in stress at the scapular spine with clinically-relevant variations in screw placement.

Primary Presenter: Erin Wylie

Project Title: *Demographics and predictors of mortality in children undergoing resuscitation at Khayelitsha Hospital, Western Cape, South Africa*

Primary Mentor: David Richards, Emergency Medicine

Thematic Area: Global Health

Abstract:

**Background**

The clinical outcomes of paediatric patients requiring resuscitation depend on physicians with specialised knowledge, equipment and resources owing to their unique anatomy, physiology and pathology. Khayelitsha Hospital (KH) is a government hospital located near Cape Town, South Africa, that sees ~44 000 casualty unit patients per year and regularly functions at more than 130% of the bed occupancy. Many of these patients are children requiring resuscitation.

**Objectives**

We sought to describe characteristics of children under the age of 12 who required resuscitation upon presentation to KH, determine predictors of mortality, and compare paediatric volume to specialist physician presence in the unit.

**Methods**

A retrospective chart review was performed on patients younger than 12 years who were treated in the resuscitation area of KH during the six-month period from 1 November 2014 to 30 April 2015.

**Results**

A total 317 patients were enrolled in the study with a median age of 14 months. The top 5 diagnoses were: pneumonia (n=58/317); neonatal sepsis (n=40/317); seizures (n=37/317); polytrauma (n=32/317); and acute gastroenteritis complicated by septic shock (n=28/317). Overall mortality was 7% (n=21/317) and mortality in children less than 1 month of age was 12% (n=5/42). Premature birth was associated with a mortality odds ratio of 8.44 (p=0.002). More than two-thirds (73%; n=231/317) of paediatric resuscitations occurred when specialist physicians were not physically present in the unit.

**Conclusion**

The study findings indicate that children under one month of age with a history of prematurity are at high risk and may benefit most from paediatric-specific expertise and rapid transfer to a higher level of care.

Primary Presenter: Minami Yamamura

Project Title: *Epidemiology of Physeal Fractures of the Distal Tibia, Proximal Tibia, and Distal Femur*

Primary Mentor: Karin Payne PhD, Department of Regenerative Medicine and Orthopedics

Secondary Mentor(s): Nancy Miller MD, Pediatric Orthopedics

Thematic Area: Public Health and Epidemiology

Abstract:

Introduction

A significant proportion of pediatric injuries consist of fractures, and 15-30% of childhood fractures involve the physis, or cartilaginous growth plate, that is responsible for longitudinal bone growth[[i]] (#\_edn1) [[ii]] (#\_edn2). Damaged cartilage within the physis can be replaced by unwanted bony repair tissue, forming a “bony bar”. Studies show that 5-10% of physeal injuries will result in a bony bar, which can lead to growth disturbances requiring significant operative interventions with varying complications [iii]. Currently, there is outdated information surrounding the epidemiology of physeal injuries and incidence of subsequent growth disturbance. Moreover, large-scale studies focusing solely on distal femur, proximal tibia, and distal tibia physeal fractures, which previously have been shown to have greatest propensity of for growth disturbances and complications, are limited [iv]. The purpose of this study is to investigate the epidemiology physeal injuries of the distal tibia/femur and proximal tibia in a more recent pediatric population, and to help physicians understand the presentation demographics and guide optimal interventional methodologies.

Methods

This is a retrospective study involving data collected from pre-existing electronic medical records of pediatric patients with femur and tibia fractures at Children 's Hospital Colorado between 2008-2018. A total of 14,301 patients were identified in the query. The study was limited to patients aged 0.5-18 years at the time of injury, distal tibia/femur and proximal tibia physeal fractures, complete patient record, and at least one follow-up visit. Patients with no fracture, non-tibia or femur fracture, non-physeal fracture, incomplete patient record, no follow-up visits, SCFEs, and proximal femur physeal fractures were excluded. Demographic and clinical variables including age, gender, injury mechanism, Salter-Harris (SH) classification, and initial treatment were collected. Outcome variables consisted of growth disturbance, subsequent interventions and its complications. The cumulative incidence of growth disturbance was estimated and descriptive statistics were used to summarize demographics and clinical characteristics among patients with and without growth disturbances.

Results

There were n=1,586 patients with proximal tibia, distal tibia, and distal femur physeal fractures who met the inclusion criteria. The average age at injury was 11.3 years ( ±3.8). Physeal fractures were more common in males (63%) and the majority affected the proximal/distal tibia (93%). SH type 2 fractures were the most prevalent (49%), followed by type 4 (23%), type 3 (20%), type 1 (9%), and type 5 (<0.1%). The overall incidence of growth disturbance was 6.1% (95% CI: 5.0 to 7.3%), including physeal bars (n=58), limb length discrepancy (n=57), valgus deformity (n=36), varus deformity (n=15) and/or coronal or sagittal plane deformity (n=4). The incidence of growth disturbance was highest among males ages 5-10. Presence of a complex fracture pattern, a distal femoral or proximal tibial fracture, initial treatment



at an outside facility, and a displaced fracture pattern were significantly [ $p < 0.05$ ] associated with increased risk of growth disturbance.

#### Discussion

The average age of physeal fracture injury was 11.3 years, with an overrepresentation of injuries in males and tibia fractures. The overall incidence of growth disturbance was 6.1%, and males ages 5-10 years with distal femur fractures had the highest predicted incidence. Variables that were significantly associated with increased risk of growth disturbance included distal femoral or proximal tibial physeal fractures, initial treatment started at an outside hospital, displaced fractures, and presence of complex fractures. Risk of growth disturbance peaked at 9.2 years for males, and 8.3 years for females, and there was a significant quadratic association identified between age at injury and risk of growth disturbance. Limitations for this study include the inherent subjectivity of fracture classification based on the reviewer, and a bias towards patients presenting with more complex physeal fractures at a large academic pediatric referral center.

Primary Presenter: Heidi Yen

Project Title: *Community Perspectives on the Racial Disparity in Infant Mortality*

Primary Mentor: Janet Meredith, Family Medicine

Thematic Area: Public Health and Epidemiology

Abstract:

Background

The United States' infant mortality rate is significantly higher among infants born to non-Hispanic Black women than infants born to women of other races, independent of educational attainment, marital status, or socioeconomic status. Addressing this disparity requires a multifaceted understanding of contributing factors and dynamics. Thus, we sought to explore community member perspectives on pregnancy, birth, and experiences in healthcare during the perinatal period.

Method

Researchers conducted focus groups with African American/Black women in the Denver community who had been pregnant previously and performed inductive thematic analysis looking at the interaction between race, perception of healthcare, and pregnancy/birthing experiences.

Results

Six focus groups (n=27) were completed. Participants reported that barriers to quality healthcare and emotional support during the perinatal time frame included being young during the time of pregnancy, having transportation difficulties, limited clinic hours, conflicting family beliefs, and being insured by Medicaid. Additionally, women perceived that healthcare professionals provide substandard care based on implicit bias. Participants felt that they lacked autonomy in decision-making related to their bodies or their babies. They also expressed an underlying mistrust in the healthcare system based on historic maltreatment of African American/Black people by medical institutions. Finally, the women described a need for more providers of color within healthcare systems.

Conclusions and Relevance

The African American/Black women in this study perceived discrimination from their healthcare providers based on race, age, and insurance status. They defined additional barriers to support including clinic locations and hours as well as differing family beliefs. To improve the relationships between African American women and their providers, participants expressed that racism and implicit bias must be recognized and addressed. Future directions based on this study include provider education on bias and healthcare disparities as well as community-based initiatives to provide support among African American/Black women during pregnancy and motherhood. It may also include system-level modifications to address bias, increase diversity within the healthcare field, and ultimately decrease the racial disparity in infant mortality.

Primary Presenter: Amy Young

Project Title: *Improved maternal iodine status during first trimester gestation with preconception nutrition supplementation: The Women First Maternal Preconception Nutrition Trial*

Primary Mentor: Nancy Krebs, Pediatrics, Section of Nutrition

Thematic Area: Global Health

Abstract:

#### Background

Iodine deficiency remains common globally, with ~25% of low and middle-income country households without iodized salt. With its critical role in embryogenesis, iodine supplementation prior to conception may be especially important in fetal development. This study compared the effect of preconception nutrition supplementation of 250 µg/day (vs no supplementation) on maternal iodine status at 12 week gestation and birth outcomes in 3 low resource settings in the Women First Preconception Nutrition Trial.

#### Methods

Women in Guatemala, India and Pakistan (n~100/arm/site) were randomized to receive multi-micronutrient fortified lipid-based nutrient supplements until delivery, starting ~3 months prior to conception (Arm 1), or starting at ~12 week gestation (Arm 2) after sample collections. Urinary iodine (µg)/creatinine (g) ratios (I/Cr) were determined at 12 wks. The cutoff for deficiency was I/Cr<150. Birth outcomes included length-for-age Z-scores (LAZ), weight-for-age Z-scores (WAZ), head circumference-for-age Z-scores (HCAZ) and BMI-for-age Z scores (BMIAZ), as well as age adjusted Z scores <-2, including stunting and wasting (LAZ<-2 and BMIAZ<-2, respectively) according to maternal urinary I/Cr status.

#### Results

At 12 wks, the adjusted mean I/Cr for Arm 1 vs Arm 2 was significantly higher for all sites (Adjusted mean: 220, 95% CI: 205,191, vs Adjusted mean: 163, 95% CI: 152,176, p<0.0001), Guatemala (Adjusted mean: 224, 95% CI: 197, 254 vs Adjusted mean: 161, 95% CI: 142,183, p=0.0003) and India (Adjusted mean: 228, 95% CI: 200, 260, vs Adjusted mean: 155, 95% CI: 135,177, p<0.0001) but not for Pakistan (Adjusted mean: 164, 95% CI: 148,182, vs Adjusted mean 176, 95% CI: 159,195, p=0.32). Prevalence of deficiency was lower in Arm 1 vs Arm 2 in Guatemala (30% vs 44%, p=0.06) and India (24% vs 47%, p<0.0004); >40% were deficient for both arms in Pakistan. For combined sites and arms, there was no significant relationship between continuous age adjusted Z scores or dichotomous age adjusted Z scores <-2 and I/Cr groups.

#### Conclusion

The preconception intervention resulted in improved maternal iodine status during the first trimester in 2 of the 3 sites. The prevalence of iodine deficiency at 12 wk in all sites suggests opportunities for enhanced implementation of iodine fortification programs.