

UNIVERSITY OF COLORADO  
DENVER  
ANSCHUTZ MEDICAL CAMPUS

ANNUAL STUDENT MSA CAPSTONE PRESENTATIONS

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UNIVERSITY OF COLORADO DENVER  
ANSCHUTZ MEDICAL CAMPUS  
MSA CAPSTONE PRESENTATIONS

Thursday, March 1, 2018

**Poster Sessions**

Session A: 1:00 pm – 2:00 pm

Session B: 2:15 pm – 3:15 pm

Session C: 3:30 pm – 4:30 pm

ANSCHUTZ MEDICAL CAMPUS  
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The MSA Directors to acknowledge, with gratitude, the support for medical student research provided by:

**The University of Colorado Denver**  
**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>Rebecca Allyn</i>	<i>Sandy Martin</i>
<i>Marsha Anderson</i>	<i>Jose Mayordomo</i>
<i>Beth Bailey</i>	<i>Janet Meredith</i>
<i>J. Scott Bainbridge</i>	<i>Niklaus Mueller</i>
<i>Erin Baschal</i>	<i>Kristen Nadeau</i>
<i>Adria Boucharel</i>	<i>Roxana Naderi</i>
<i>Joe Brzezinski</i>	<i>Ram Nagaraj</i>
<i>Amelia Challender</i>	<i>David Orlicky</i>
<i>Angela Czaja</i>	<i>Madhoosudan Patil</i>
<i>Robert Dellavalle</i>	<i>Jennifer Patnaik</i>
<i>Colleen Dingmann</i>	<i>Jennifer Post</i>
<i>Caleb Doll</i>	<i>Irene Schauer</i>
<i>Michele Doucette</i>	<i>Michaela Schedel</i>
<i>Marisa Echaniz</i>	<i>Robert Sclafani</i>
<i>Evgenia Gerasimovskaya</i>	<i>Kimber Simmons</i>
<i>Adit Ginde</i>	<i>Meredith Tennis</i>
<i>Jackie Glover</i>	<i>Natalia Vergara</i>
<i>Daniel Goldberg</i>	<i>Melinda Wilding</i>
<i>Paul Johnson</i>	<i>Rui Zhao</i>
<i>David Keller</i>	<i>John Tentler</i>
<i>Bethany Kwan</i>	<i>Steven Lowenstein</i>
<i>Rita Lee</i>	

Primary Presenter: **Alex Alanis**

Project Title: *Post-Concussion Return-to-learn Protocols in School-Aged Children*

Primary Mentor: Sonja O'Leary

Thematic Area: Public Health and Epidemiology

Abstract:

**Background:** Much research and recommendation has been done in regards to safe management of mild traumatic brain injury (mTBI), also termed a concussion, and returning to play. There is less agreement regarding the best approach to returning to the classroom after a mTBI. This article examines the best current research and recommendations regarding "return-to-learn" then describes steps taken to distribute the summary of current knowledge into an integrated medical and educational treatment team at a large public school system in Denver, CO using a collaborative approach.

**Methods:** A literature review of the most current research on mTBI and return to learn was performed, interviews were conducted with a government lobbyist and a parent advocate and with leaders in mTBI management.

**Results:** Educational material on concussion/mTBI symptomatology and how to optimize recovery was developed and distributed to guardians and educators via School Based Health Centers.

**Conclusion:** Through the development and distribution of educational material, we aim to assist guardians and educators in identifying symptoms of a mTBI that their student may be experiencing, recognize "red flag" symptoms that require immediate attention from a medical team, and most importantly, using this knowledge to optimize reintegration back into the classroom in order to set the student on a path to success.

Primary Presenter: **Matthew Applegate**

Project Title: *Perceptions and self-reported marijuana use among patients with epilepsy*

Primary Mentor: Edward Maa

Thematic Area: Clinical Science

Abstract:

Background

As states like Colorado continue to loosen regulations around the possession of marijuana, more patients are using marijuana for the treatment of epilepsy. In 2011, Denver Health surveyed their patients about complementary and alternative medicines (CAM) for the treatment of epilepsy and found that 33% were already using marijuana. The purpose of this study is to determine if epilepsy patients are using marijuana medicinally and determine their attitudes toward medical marijuana use in epilepsy.

Methods

We surveyed 53 patients at the Denver Health's Comprehensive Epilepsy Clinic, a county hospital in Denver, Colorado. The survey was self-administered and voluntary.

Results

Compared to the previous CAM survey, a similar proportion of participants reported using marijuana (34% vs 34% in CAM survey). Of the 18 participants reporting using marijuana in the last year, 14 (78%) reported using marijuana for medicinal purposes, with 79% scheduling the use of marijuana like a medication, and 85% reporting use multiple times per day. Medical marijuana users reported using strains known to be high in cannabidiol (43%) but also reported using strains known to be high in tetrahydrocannabinol (21%) and high in both (14%). Responders reported a subjective decrease in both the frequency and severity of their seizures and none felt marijuana increased the frequency or severity of their seizures. When asked about withdrawal effects of stopping marijuana, 39% felt there was a withdrawal effect. No users reported long-term adverse effects.

Conclusions

Although this is a small sample size, the data indicate that there is a group of participants using marijuana as if it were another medication to treat their seizures. They use marijuana regularly in addition to their current medications. They believe in the efficacy of marijuana to treat their epilepsy while being a safe adjuvant with few side effects. Further study on commercially available marijuana and its safety and efficacy in the treatment of epilepsy is necessary.

Primary Presenter: **Stephen Asay**

Project Title: *Use of Video Media for the Instruction of Physical Examination in the Preclinical Years*

Primary Mentor: Todd Guth

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Physical examination remains a core clinical skill of any practicing physician, both for the purposes of connecting with patients, and as one of the most reliable and readily-available diagnostic tools clinicians have. Medical education at all levels, from national accrediting and licensing bodies to individual medical schools continue to emphasize competencies in physical examination, with training based in face-to-face instruction, standardized patient sessions, and limited clinical experiences prior to the clinical training years. The dropping cost of video production, paired with widely-available and popular web-hosting platforms have made this a golden age for the use of video and other web-based media in medical education. Moreover, the use of these media may complement resource and time constraints medical schools face in teaching core clinical skills. We developed an instructional video series under the University of Colorado School of Medicines Foundations of Doctoring Curriculum to supplement the physical examination instruction, and to determine if application of this media was a feasible resource that students would take advantage of. In post-distribution surveys following the students first OSCE, we found that responding students received the videos exceptionally well as a supplement to the standard curricular resources provided to them.

Primary Presenter: **Anna Astashchanka**

Project Title: *Mucin-2 (Muc-2) modulates the behavior of breast cancer*

Primary Mentor: Dascanio Jacobsen

Thematic Area: Basic Biomedical Science

Abstract:

**Background:** Metastasis and therapeutic resistance are major obstacles in treating patients with breast cancer. Breast tumors that secrete mucus are generally resistant to chemotherapy. One type of secreted mucin, Mucin-2 (Muc2), is expressed in some breast cancers, but absent in non-neoplastic breast tissue. This suggests that Muc2 may play a role in modulating breast cancer biology. Whether Muc2 expression correlates with breast cancer patient survival is controversial.

**Methods:** To determine the effects of Muc2 on breast cancer cell proliferation, metastasis, and hormone receptor expression, we developed *en vivo* and *en vitro* experimental models using PT12 and BCK4 cell lines, which heterogeneously express MUC2. Transfecting these cell lines with lentiviral RNA allowed us to compare behavior between non-targeted control (shNT) vs decreased MUC2 cells (shMUC2.) Decreased expression of Muc2 was confirmed using immunoblotting. Proliferation *en vitro* was measured using the IncuCyte live cell imaging system and manual cell count. BCK4 and PT12 cells with shNT or shMuc2 were injected subcutaneously in immunocompromised mice and grown as solid tumors, which were tracked by caliper measurements. BCK4 cells with high (shNT) and low Muc2 (shMuc2) were labeled with luciferase and injected intracardially into NSG mice treated with estradiol. Metastasis was monitored via IVIS imaging.

**Results:** Decreased Muc2 expression decreased proliferation in BCK4 and PT12 cells versus non-targeting control cells both *in vitro* and *in vivo*. *En vivo* models of BCK4 and PT12 demonstrated a significant decrease in MUC2 expression in shMUC2 primary tumors. Decreased MUC2 expression appears to upregulate estrogen receptor in both PT12 and BCK4 tumors. Decreased MUC2 expression, in addition, leads to decreased MCM2 expression. BCK4 metastasis demonstrated predilection to bone, lung, ovary and uterus, each with variable MUC2 expression. shMUC2 metastasis demonstrated global decrease in metastasis in comparison to control mice.

**Conclusion:** Muc2 expression plays an important role in mediating proliferation, apoptosis, hormone receptor expression, and metastasis of breast cancer cells. These data suggest that Muc2 is important in controlling the biology of Muc2 positive breast tumors. In addition, Muc2 may be important in guiding treatment and predicting outcomes in breast cancer patients.

Primary Presenter: **Corey Badgett**

Project Title: *Student-run Clinic Effect on Emergency Department Utilization (SCEEDU)*

Primary Mentor: Kari Mader

Thematic Area: Public Health and Epidemiology

Abstract:

## Background

Emergency department (ED) congestion is a widely-accepted problem that has continued to worsen over several decades. In addition to affecting patient care, there are significant financial implications to the overuse of emergency services. While this problem is multifactorial, one commonly-cited cause is the use of emergency departments for conditions which can be appropriately managed in primary care settings. Background studies on the topic have yielded mixed results, but almost all point to improving access to regular primary care services as a potential remedy. Student-run free clinics (SRFC) have become more prevalent at medical education centers across the country and aim to provide care to those with limited means. As one of these safety-nets, the DAWN clinic serves the indigent population of Aurora, Colorado and is interested in measuring the effect of providing primary care on local emergency services utilization.

## Objective

The purpose of this study is to measure the effect of receiving primary care services at the DAWN clinic on University of Colorado ED utilization before and after enrollment. We predict that enrollment at the DAWN clinic for primary care services will reduce all-cause ED visits.

## Methods

We used DAWN Clinics Electronic Health Record to generate a list of patients who established care at the DAWN clinic and crossmatched this list with the University of Colorado's Emergency Department data to compile a de-identified list of DAWN patients who have been seen at the University of Colorado ED. A paired t-test was used to analyze the raw number of emergency department visits to DAWN Clinic visits. We then applied a regression model to examine clinically relevant covariates.

## Results

Patients that had ED visits both before and after enrollment in the DAWN clinic showed a marked reduction in average ED visits/month, from an average of 0.350 to 0.070. The total number of ED visits was also decidedly reduced, from 150 total visits in the time before DAWN enrollment to 29 after establishing care.

## Conclusions

Patient enrollment at the DAWN clinic effectively reduced all-cause ED visits.



Primary Presenter: **Luke Baldelli**

Project Title: *A survey of youth with new onset type 1 diabetes: Opportunities to reduce diabetic ketoacidosis.*

Primary Mentor: Guy Todd Alonso

Thematic Area: Public Health and Epidemiology

Abstract:

**Objective:** Pediatric patients in Colorado with new onset type 1 diabetes (T1D) presenting with diabetic ketoacidosis (DKA) increased from 29.9% to 46.2% from 1998 to 2012. The purpose of this study was to compare differences between patients with newly diagnosed T1D who presented in DKA with those who did not across three domains: sociodemographic factors, access to medical care, and medical provider factors, aiming to identify potential targets for intervention.

**Methods:** Sixty-one patients <17 years of age with T1D duration <6 months completed the questionnaire. Groups were compared using Fishers exact test or the Kruskal-Wallis test.

**Results:** Parents of 28% of patients researched their child's symptoms on the Internet prior to diagnosis. At the first healthcare visit for symptoms of T1D, 23% were not diagnosed. There were no significant differences between groups (DKA vs non-DKA) in demographics, first healthcare setting for T1D symptoms, provider type at first visit or at diagnosis, insurance status, or specific barriers to care. DKA patients had a longer interval between previous well visit to diagnosis (median 172 vs 263 days,  $P = 0.01$ ). Non-DKA patients were more likely to have blood glucose measured at  $P = 0.02$ , and had fewer symptoms prior to ( $P = 0.01$ ) the first visit for diabetes symptoms. Parents of non-DKA patients were more likely to be familiar with symptoms of diabetes ( $P < 0.001$ ) and to suspect diabetes ( $P = 0.01$ ).

**Conclusion:** Targets for campaigns to prevent DKA include increasing provider glucose and ketone testing, increasing public knowledge about diabetes, and understanding how sociodemographic factors may delay T1D diagnosis.

Primary Presenter: **Charles Behnfield**

Project Title: *Outpatient laparoscopic appendectomy can be successfully performed for uncomplicated appendicitis: A Southwestern Surgical Congress multicenter trial*

Primary Mentor: Clay Burlew

Thematic Area: Clinical Science

Abstract:

**Background:** Many laparoscopic procedures are now performed on an outpatient basis. We hypothesize laparoscopic appendectomy can be safely performed as an outpatient procedure.

**Methods:** Seven institutions adopted a previously described outpatient laparoscopic appendectomy protocol for uncomplicated appendicitis. Patients were dismissed unless there was a clinical indication for admission. Patient demographics, success with outpatient management, time of dismissal, morbidity, and readmissions were analyzed.

**Results:** Two hundred six men and one hundred seventy women with a mean age of 35.4 years were included in the protocol. Seventy-eight patients (21%) had pre-existing comorbidities. 299 patients (80%) were managed as outpatients. There were no conversions to open appendectomy. Postoperative morbidity was 5%. The time of patient dismissals was evenly distributed throughout the day and night. Twelve patients (3%) required readmission. Outpatient follow-up occurred in 63% of patients.

**Conclusions:** An outpatient laparoscopic appendectomy protocol was successfully applied at multiple institutions with low morbidity and low readmission rates. Application of this practice nationally could reduce length of stay and decrease overall health care costs for acute appendicitis.

Primary Presenter: **Michael Berger**

Project Title: *Development of a Policymaking Curriculum Module for Healthcare Providers and Students*

Primary Mentor: Jeremy Long

Thematic Area: Public Health and Epidemiology

Abstract:

Health care in the United States has undergone major changes following passage of the Patient Protection and Affordable Care Act (PPACA). Proposals to seriously revamp important parts of the legislation are continually on the table at the federal level. These changes also affect how states, counties, cities, and organizations react. Health care providers in all disciplines have a unique perspective on the effects of policy changes at all levels through their experiences caring for patients. A needs assessment was completed to help direct the design of a policymaking and advocacy curriculum module for health care providers and trainees. The curriculum includes a workshop where learners will put their knowledge and skills to use in completing an advocacy activity. The curriculum will be taught to a cohort of third-year medical students at the University of Colorado School of Medicine in March 2018. An outcomes analysis will be completed following the course to help refine the curriculum.

Primary Presenter: **Andrew Black**

Project Title: *An Evaluation of the Effectiveness of a Medical School Musculoskeletal Curriculum at The University of Colorado School of Medicine*

Primary Mentor: Frank Scott

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Background: Musculoskeletal complaints are among the most common and important medical problems yet musculoskeletal education has been widely and consistently reported as inadequate in US medical schools.

Methods: A 25-question, nationally validated musculoskeletal competency exam was given to the University of Colorado Denver, School of Medicine third year medical students. A survey was also given to second and third year medical students to assess students level of interest in musculoskeletal medicine and their feedback regarding the curriculum.

Results: For the competency exam the mean score was 69.0%. 48/107 (44.9%) students reached the minimum passing score of 70%. There was no difference in performance between students with differing levels of interest in musculoskeletal medicine. Free-response feedback from both classes featured themes of more hands-on learning, a longer clinical block, and more small-group learning sessions.

Conclusions: Third year medical students at the University of Colorado Denver scored relatively well on the exam when compared with other published results of this metric.

Student feedback suggests the 2-week musculoskeletal block is useful and relevant to their future careers. However, there is still much room for improvement in our musculoskeletal curriculum, as shown by the 55% fail rate on the competency exam.

Primary Presenter: **Aleksandar Blubaum**

Project Title: *Efficacy of Health Care Pipeline Programs: A Review and Comparison of the Summer Health Careers Institute and the Colorado Health Professions Development Scholars Program*

Primary Mentor: Jennifer Hellier

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

**Purpose:** Educational pipeline programs are an important component of Area Health Education Centers and support the recruitment of youth, especially from disadvantaged backgrounds, including rural and urban underserved communities and underrepresented minority students, to pursue health care professions. It is unclear what variations exist in the outcomes of a pipeline program targeting high school students compared to one targeting college students. We aim to evaluate and compare the longitudinal outcomes of two such programs.

**Methods:** All students who participated in the Summer Health Careers Institute (SHCI) between 2009-2014 and the Colorado Health Professions Development (CO-HPD) Scholars Program between 2010-2015 were identified. Data from the National Student Clearinghouse was collected for all students regarding their known college matriculation, graduation, and degree information. Fishers exact test was used to compare the data and outcomes between the SHCI and CO-HPD programs.

**Results:** 470 high school students participated in the SHCI between 2009-2014 and 291 college students participated in the CO-HPD scholars program between 2010-2015. Ethnically, 163 (35%) of SHCI participants and 64 (22%) of CO-HPD participants belonged to an underrepresented minority (URM) group [ $p=0.0002$ ]. Geographically, 364 (77%) of SHCI participants and 153(53%) of CO-HPD participants represented rural and urban underserved backgrounds [ $p<0.0001$ ]. Academically, 191 (42%) and 217 (44%) of the certificates/degrees being pursued and earned by SHCI and CO-HPD participants respectively were terminal certificates/degrees in health professions [ $p=0.69$ ].

**Conclusions:** The SHCI and CO-HPD scholars program, high school and college healthcare pipeline programs respectively, were equally effective in maintaining participants interest in pursuing terminal certificates/degrees in health professions. Despite this, challenges remain. Important differences were noted between program participants ethnic and geographic backgrounds, as well as their degree of further educational pursuits, highlighting the need for continued refinement of both programs.

Primary Presenter: **James Bowie**

Project Title: *ACL Injuries in Youth: An Umbrella Review*

Primary Mentor: Jay Albright

Thematic Area: Clinical Science

Abstract:

**Background:** There is a significant amount of available literature that discusses ACL injuries. This includes examining risk factors for ACL injuries, ACL injury risk reduction, proper ACL injury treatment, ACL reconstruction rehabilitation, and chronic issues following ACL injuries. One area of importance regarding ACL injuries is those injuries specifically in youth/pediatrics. This is of significance for a myriad of reasons including concerns regarding a secondary ACL rupture, chronic conditions following injury including early onset osteoarthritis, and attenuation of proper bony growth secondary to ACL reconstruction. Because of this importance, this umbrella review intended to highlight recent systematic reviews discussing ACL injuries in pediatric populations.

**Methods:** Multiple databases were searched using a customized search strategy resulting in 23 different systematic reviews. Of these, 5 fit the inclusion criteria to be included in the analysis.

**Results:** Of the included articles, there were three central themes, being 1) ACL injury prevention, 2) injury treatment and 3) post-surgical rehabilitation. ACL injury prevention: there was an overall reduction in ACL injuries in preventative NMT groups in general with an additional emphasis on strengthening, proximal control exercises, and multiple exercise interventions as compared to control groups. Injury treatment: delayed/non-surgical treatment of ACL injuries resulted in an increased likelihood of clinical instability/pathological laxity, subsequent meniscal tears, and a worse return to activity rate when compared to standard ACL repair. However, review of relevant reviews found a poor Coleman Methodology Score Average (44.7 +/- 9.2 (range, 28 to 62)). Post-surgical rehabilitation: authors found a poor mean quality index percentage (47.1% [ 32â€“61%]) for the ten applicable studies and no common themes to allow for further examination.

**Conclusion:** The articles highlighted those preventative methods like neuromuscular training might help reduce ACL injury incidence in female youth and that prompt surgical stabilization is the ideal treatment choice as compared to conservative/delayed treatment for ACL injuries in youth. More importantly, the issues regarding the current state of ACL injury literature in adolescence are discussed including poor methodological quality and incongruent outcomes.

Primary Presenter: **Cody Brevik**

Project Title: *DISCOVER HEALTH PROJECT: RURAL COMMUNITY OUTREACH AND HEALTH EDUCATION THROUGH LIBRARY-BASED PROGRAMS*

Primary Mentor: Jennifer Hellier

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Rural areas in Colorado have less access to health education resources than urban cities. Resources such as health outreach initiatives, museum health exhibits, and programming are valuable and beneficial to all communities. The primary overarching goal and purpose of the project is to improve access to health-related educational materials by physically bringing these resources into the communities that need them the most. This enables them to learn about pertinent health issues, how to take care of their health, and encourages more active engagement in their own health. Thus, a bilingual library-based rotating health exhibit with educational programming was developed to target high need areas, with the highest need areas identified as being primarily rural and Hispanic communities. Another long-term major goal was to increase healthcare access, literacy, and support through encouraging youth from these communities to pursue careers in the various health fields. This element was also incorporated into the project in almost all aspects. As of this writing, the exhibit has completed rotations at four libraries. The plan is to conduct pre and post surveys of the health education programming, and obtain demographic data and surveys of the exhibit as a whole to measure the effectiveness of these educational methods. The project has major potential to make positive contributions to the health literacy of these communities. However, there is currently not enough data to arrive at any conclusion regarding the true impact of the programming.

Primary Presenter: **Kimberly Cabral**

Project Title: *Failure To Thrive Among Refugee Children: A Quality Improvement Project To Innovate A Primary Care Approach*

Primary Mentor: Elizabeth Kvach

Thematic Area: Global Health

Abstract:

There is a paucity of data regarding failure to thrive among immigrant and refugee populations within the United States despite the abundant information regarding the refugee populations. Within the Lowry Clinic of Denver Health in Colorado there have recently been dramatic increases in the refugee populations as well as refugee children that meet criteria for failure to thrive. Amongst the largest population are Bhutanese Nepali-speaking patients. The physicians felt that the traditional model of standard patient care was inadequate due the 15 minute time allotment, referrals to outside clinics and loss of follow up. Therefore, a quality improvement project was implemented to create a rapid cycle change in treatment of failure to thrive within the clinic. A group of Bhutanese Nepali-speaking failure to thrive refugee children and their parents were enrolled in 4 group visits. A nurse coordinator scheduled patient reminders and follow ups and the group visits followed an interdisciplinary approach with pediatricians, family medicine physicians, residents, interpreters/cultural brokers, and nurses present. All participants were educated with master failure to thrive documents and a curriculum was developed which included an educational talk, a cooking demonstration and practicing meal-time behaviors. At each visit, the height and weight of each child were recorded and will be used as a comparison to a failure to thrive child receiving standard care. The small absolute numbers of patients in the project and convenience sampling make it difficult to draw direct conclusions regarding the impact of the GV intervention on growth parameters of patients over time. However, we describe other clinically meaningful outcomes, including improved rates of clinical follow up likely secondary to RN care coordination as well as increased provider confidence and satisfaction treating patients with FTT.



Primary Presenter: **Sarah Cain**

Project Title: *Developing a measure to explore contraception decision making in adolescents*

Primary Mentor: Andrea Hoopes

Thematic Area: Public Health and Epidemiology

Abstract:

**Purpose:** Adolescents are maturing physically, cognitively, and psychosocially during the second decade, thus have evolving health care decision-making support needs. Contraception decision-making is a particularly complex task for some adolescents given the context and variables involved in this decision. The purpose of this study was to develop a measure that can be used to assess an adolescents contraceptive counseling needs.

**Methods:** For this descriptive study, we recruited English-speaking females aged 13 – 19 years attending an adolescent family planning clinic associated with an urban childrens hospital. Participants were asked to complete a questionnaire with items including preferred contraception characteristics and possible side effects, friend and family member opinions, the participants own experience with seeking healthcare or health information, motivations behind seeking contraception, and barriers to use.

**Results:** XXX participants completed a questionnaire (age range 13-19, median XX years). XX% were black/African American, XX% white, XX% Native American, XX% Asian/Pacific Islander, and XX% described themselves as something else. Nearly half of the participants identified as Hispanic. XX had public insurance, XX% had private insurance, and XX% were uninsured. We selected XX items to remain in our preliminary measure (Table). Measure components included autonomy during health care visits, independence managing health, side effects affecting physical and emotional status, side effects affecting menstrual function, benefits of method, trustworthiness of method, life planning, uncertain circumstances, and high-risk circumstances. Standalone items were control over method, feeling loved or supported, and abortion values.

**Conclusions:** Future studies may explore interventions linked to this measure to assist adolescents and providers with contraception management decisions.

Primary Presenter: **Diego Camacho**

Project Title: *Imaging predictors of tumor response and survival among hepatocellular carcinoma patients treated with transarterial chemoembolization*

Primary Mentor: Thor Johnson

Thematic Area: Clinical Science

Abstract:

Purpose

Given the central role of IR in treating hepatocellular carcinoma (HCC), improvements in survival prediction and decreased complications are of prime importance to Interventionalists. The aggressiveness of HCC results in suboptimal outcomes mandating assessment of tumor factors that may affect outcomes and complications. HCC is strongly associated with hepatic arteriovenous (AV) shunts and tumors with AV shunts may demonstrate reduced treatment efficacy as well as increased rates of complications from particles shunting through the liver and into the lungs. The aim of this study was to determine if high levels of shunting, as determined by pre-procedure multiphase computed tomography (CT) is associated with patient outcomes.

Materials and Methods

This study was approved by the local institutional review board; informed consent was waived. Data were retrospectively collected on a cohort of patients with treatment-naïve HCC who underwent Drug Eluting Embolic-TACE (DEE-TACE), which included pre- and post-procedure multiphase CT between March 2009 and February 2013. A total of eighty-three patients were included in the analysis. Pre-procedure multiphase CT was evaluated for evidence of early venous opacification, implying AV shunting. Tumor response was evaluated using Modified Response Evaluation Criteria in Solid Tumors (mRECIST). Multivariable linear regression was used to assess the association between AV shunts and tumor response. A Cox proportional hazards model was used to evaluate the association between AV shunts and all-cause mortality. Finally, tumor response was evaluated as a mediator in the relationship between AV shunting and all-cause mortality using the method proposed by Iacobucci.

Results

Patients with AV shunting had a percentage change in tumor diameter that was 38.18% higher (1.69cm longer) than those without ( $p=0.0024$ ; 95% CI: 13.96% to 62.41%). A Cox proportional hazards model found that no significant association existed between percentage change in tumor diameter and the hazard of patient death ( $p=0.1732$ ; 95% CI: 0.726 to 5.918); however, when categorizing the percentage change in tumor diameter there was a significant association between categorized tumor response and the hazard of patient death ( $p=0.0034$ ). Iacobucci's methodology did not find that the percentage change in tumor diameter was a significant mediator in the relationship between shunting and overall hazard of patient death ( $p=0.7381$ ).

Conclusions

Patients with HCC and AV shunting respond less to treatment with DEE-TACE than those without shunting. Further investigation with a patient cohort without transplantation may help to determine the impact of AV shunting on patient survival as measured by this method.

Primary Presenter: **Eduardo Carrera**

Project Title: *The Influence of Hearing Aids and Cochlear Implants on Balance during Ambulation*

Primary Mentor: Timothy Hullar

Thematic Area: Clinical Science

Abstract:

**Objectives:** Increasing evidence suggests that auditory inputs are important for maintaining postural stability, but little is known about their effects on dynamic balance. We hypothesize that hearing aids and cochlear implants have a corrective effect on balance during ambulation in the presence of sound localizing sources when compared to unaided situations. **Study Design:** Case control.

**Methods:** We tested 20 adults who were experienced users of bilateral hearing amplification (4 bilateral hearing aids, 8 bilateral cochlear implants, and 8 bimodal users) performing the Unterberger (Fukuda) stepping test, which is a common clinical measure of dynamic stability. Testing was carried out in the presence of a 65 dBA white noise point sound source located at ear level 1.85 m in front of the participant. The median of the absolute angle of rotation from the starting position after 50 paces was recorded. 15 subjects performed poorly during an initial screening in the unamplified condition (error >20 deg). We then retested these subjects in a unilaterally and bilaterally aided condition to determine if augmenting auditory input could improve their performance.

**Results:** Subjects performed better in the bilateral aided condition compared to the unaided condition ( $p=0.0322$ ). Bilateral amplification was also better than in the unilateral condition ( $p=0.0163$ ), which was no different from the unaided condition.

**Conclusions:** Our results suggest that hearing aids and cochlear implants can be considered as balance rehabilitation devices, but only when used bilaterally. Unilateral amplification provides little benefit perhaps due to poor sound localization of monaural listeners.

Primary Presenter: **Jackie Carrico**

Project Title: *Primary Care Provider Attitudes Toward Opioid Prescribing and Patient Satisfaction-Based Incentives*

Primary Mentor: Karsten Bartels

Thematic Area: Public Health and Epidemiology

Abstract:

**Purpose:** The opioid epidemic in the United States is an ongoing public health concern. Healthcare institutions utilize standardized patient satisfaction surveys to assess the patient experience, and some offer incentives to their providers based on the results. We hypothesized that providers who report being incentivized based on patient satisfaction surveys are more likely to report an impact of such surveys on their opioid prescribing practices.

**Methods:** We developed a 23-item survey instrument to assess the self-perceived impact of patient satisfaction surveys on opioid prescribing practices in primary care and the potential impact of institutional incentives. The survey was administered as an open digital survey, accessible by a unique internet link which was emailed to all 1404 members of the Colorado Academy of Family Physicians. Groups were compared using Fishers exact and chi-square tests.

**Results:** The response rate to the online survey was 10.4% (n=146). Clinical indications for which responders prescribe opioids included acute pain (93%), cancer pain (85%), and chronic non-malignant pain (72%). Thirty-six percent of physicians incentivized by surveys reported some impact on opioid prescribing compared to 12% of physicians using surveys but not incentivized ( $p=0.0059$ ).

**Conclusions:** Efforts to improve patient satisfaction may have potentially untoward effects on providers opioid prescribing habits. Our results suggest a need for critical reassessment of patient satisfaction surveys in ambulatory care settings, especially their use in provider incentive plans.

Primary Presenter: **Paola Casillas**

Project Title: *Engaging Teens in Weight Management Conversations: A Qualitative Community-Based Participatory Research Study*

Primary Mentor: Janet Meredith

Thematic Area: Clinical Science

Abstract:

Background and Objectives:

Childhood obesity is an ever-growing health epidemic, with rates tripling over the past few decades and a disproportionate burden found in neighborhoods surrounding the University of Colorado Anschutz Medical Campus in Aurora.<sup>1, 8,13</sup> In order to address this rising health concern, this research team studied the experiences of teens and providers who had weight management conversations in the healthcare setting using survey and teenage focus groups. Our objective is to learn how providers might lead more effective conversations with teenagers regarding weight. We hope this research will improve strategies for weight-related dialogue between teenagers and their healthcare providers and, ultimately, lead to improved health outcomes in the community and beyond. The direct input from teenagers makes this project novel, with equivalent studies lacking this input.

Methods:

This study was performed via community-based participatory research (CBPR), in which research design and implementation were done in conjunction with a teenage advisory board (TAB). After collaborating with the TAB to create a focus group protocol, teenagers were recruited from local schools to participate in focus groups, during which they shared their experiences of weight management conversations with healthcare providers and made suggestions for improvements. Focus groups were audio-recorded, transcribed, then qualitatively analyzed using open coding by three separate coders. Then, electronic and paper surveys were distributed to local providers about their experiences discussing weight with teenage patients. The protocol was IRB exempt: 13-1670.

Results:

Three separate sets of gender-separated focus groups have been conducted so far, the first of Latina/Latino teens, the second of mixed race, and the third with African Americans. All participating teens believed it was important for health care providers to know how to conduct weight management conversations with their teenage patients and most had had experiences with such conversations in the past. The following five main themes were derived from the focus groups: 1) make opening the conversation more comfortable by first getting to know the teenager, 2) discover the teens individual goals and motivations for health and weight in order to better tailor advice, 3) provide a written weight management plan composed of a few steps at a time which include concrete and individualized suggestions, 4) provide realistic expectations for weight loss, and 5) support them with frequent follow up and verbal encouragement. Results of the provider survey showed that providers are having these conversations when necessary, they are fairly comfortable having the conversations, but they do not

think they are effective in achieving positive results regarding patients' weight. Additionally, providers are very interested in learning about teen-approved methods to improve these conversations.

#### Conclusions:

While teens agree that the conversations they have with their health care provider are a very important part of their weight management journey, they have many ideas for how these can be improved. Based on the provider survey, providers do bring up the topic, but feel that their conversations could use much improvement. Further research will be performed to reach a wider pool of teens through teen surveys, and to study the results for efficacy and efficiency in actual practice. We plan to continue to share our findings with providers who see teenagers.

Primary Presenter: **Tae Chang**

Project Title: *Access to Care Under the Affordable Care Act: The Challenges Insured Patients Face When Attempting to Utilize Their Behavioral Health Benefits*

Primary Mentor: Deb Seymour

Thematic Area: Public Health and Epidemiology

Abstract:

The Affordable Care Act mandates that health insurance plans include sufficient access to behavioral health providers, but lacks specific guidelines to define sufficient access. Using a secret shopper methodology, we called behavioral health providers in the Denver metro area networked with three large insurance companies. We found that depending on insurance company and level of training, 9.8-59.0% of providers could offer a new patient appointment, with psychiatry appointments being particularly difficult to schedule. These findings are consistent with similar studies conducted in other regions, suggesting access to outpatient behavioral health care is limited despite existing ACA regulations.



Primary Presenter: **Erik Christensen**

Project Title: *The South African emergency medicine elective: A unique approach to global health education among medical students*

Primary Mentor: Jennifer Bellows

Thematic Area: Global Health

Abstract:

As international electives become increasingly popular among students, medical schools have expanded their integration of global health elective curricula. Ideally, these programs foster clinical knowledge and personal growth in the student participant while providing a lasting benefit to the host site. However, many such programs suffer the common pitfalls of inadequate student preparation and insufficient oversight while abroad. Additionally, the community visited is at risk of being exploited with little meaningful benefit to their patients or medical system. The CUSOM (University of Colorado School of Medicine) South Africa Elective (SAE) is a distinctive program that aims to minimize these limitations while retaining benefit to the student. Extensive participant selection, formalized pre-departure preparation, and direct in-country clinical oversight ensure that students and hosts are optimally insulated from risks associated with short-term global health trips. A focus on collaborative research and longitudinal relationships with South African emergency physicians ensure a symbiotic partnership between hosts and participants. In surveying a decades worth of SAE alumni, we find the model of the South Africa Elective uniquely implements many of the standards of a successful global health elective while avoiding many of the common hazards.

Primary Presenter: **Alexandra Colvin**

Project Title: *A Rare Case of Condylomata Acuminata of the Urinary Bladder and a Review of the Literature*

Primary Mentor: Shandra Wilson

Thematic Area: Clinical Science

Abstract:

Introduction:

Condyloma acuminata (CA) are the manifestation of an infection with Human Papilloma Virus (HPV). CA is more commonly found on the external locations, and rarely cause infections within the urinary bladder.

Case Description:

We present a case of a high-risk HPV genotype condyloma acuminata of the urinary bladder in a 51-year old male, with no history of external condyloma acuminatum. The patient has no personal history of sexually transmitted infections and presented with a 16-year history of squamous metaplasia and keratinization of the bladder, resulting in gross hematuria. He had previously undergone a trans-urethral bladder resection (TURBT) at an outside hospital. A computerized tomography (CT) scan for further assessment of his bladder mass and hematuria showed a lobulated enhancing mass in the left posterior urinary bladder suspicious for carcinoma. In addition, a posterior diverticulum and smaller lateral diverticulum were observed. This was followed by a transurethral cystoscopy in which a 4 cm area of atypical flat lesion was completely resected by transurethral resection.

Conclusion:

Histological examination showed squamous papilloma, with extensive koilocytic changes and no evidence of malignant invasion. HPV DNA in situ hybridization was performed and found to be negative for low-risk HPV (6, 11) and positive for high-risk HPV (16, 18, 31, 33, 35, 39, 45, 51, 56, 58, 59, 68). The final diagnosis was condyloma acuminata of the urinary bladder. Our patient is unique because he was not immunosuppressed and had no related genital lesions, but a positive clinical history of HPV in his partner.

Key words: condyloma acuminata, urinary bladder cancer, human papilloma virus

Primary Presenter: **Michael Cookson**

Project Title: *Antenatal Vitamin D Preserves Placental Weight and Vessel Density and Fetal Growth After Intra-amniotic Endotoxin Exposure*

Primary Mentor: Duong Mandell

Thematic Area: Basic Biomedical Science

Abstract:

Antenatal Vitamin D Preserves Placental Weight and Vessel Density and Fetal Growth After Intra-amniotic Endotoxin Exposure

Michael W. Cookson, Sharon Ryan, Gregory J. Seedorf, Blair Dodson, Steven H. Abman, Erica Mandell  
Pediatric Heart Lung Center, Department of Pediatrics, University of Colorado, School of Medicine, Aurora, CO.

**Background:** The placenta is a major site for vitamin D metabolism. Antenatal intra-amniotic (IA) endotoxin (ETX) exposure in fetal rats causes high neonatal mortality and late morbidity, including abnormal lung structure and pulmonary hypertension during infancy. The biologically active form of vitamin D, 1,25-dihydroxyvitamin D<sub>3</sub> (1,25-(OH)<sub>2</sub>D<sub>3</sub>), improves survival and lung structure in infant rats after IA ETX. Whether the protective effects of IA 1,25-(OH)<sub>2</sub>D<sub>3</sub> treatment are due to direct effects on the fetus or improved placental vascular development remain unknown.

**Objective:** To determine if 1,25-(OH)<sub>2</sub>D<sub>3</sub> treatment could improve placental vascularity after IA ETX exposure during late gestation in pregnant rats.

**Design/Methods:** Fetal rats were exposed to ETX (10mg), ETX + 1,25-(OH)<sub>2</sub>D<sub>3</sub> (1ng/ml), 1,25-(OH)<sub>2</sub>D<sub>3</sub> (1ng/ml), or saline via IA injection at E20 and delivered two days later. To assess placental vascular development, histologic sections from the placenta were stained for CD31 and vessel density per high power field (HPF) was determined and analyzed using Matlab software.

**Results:** IA ETX reduced placenta and newborn birth weight by 22% and 17%, respectively, when compared to controls (placental weight: 0.66g v. 0.52g; p< 0.001; birth weight: 4.82g vs. 5.69g; p<0.001). IA 1,25-(OH)<sub>2</sub>D<sub>3</sub> treatment increased birth weight by 10% in ETX exposed pups (5.34g vs. 4.82g; p<0.005). Placental vessel density was reduced after IA ETX exposure by 24% in comparison with controls (1114 (+/-40.65) v. 847 (+/-16.81) vessels per HPF; p<0.05). Treatment with IA 1,25-(OH)<sub>2</sub>D<sub>3</sub> increased placenta vessel density 2-fold after ETX exposure (847 (+/-16.81) v. 1739 (+/-95.88); p<0.0001), and increased vessel density in placentas from saline controls by 31% (1114 (+/-40.65) v. 1619 (+/-67.89); p<0.001).

**Conclusions:** IA ETX decreases placental and pup weight at birth. Antenatal 1,25-(OH)<sub>2</sub>D<sub>3</sub> improved newborn rat weight and placental vessel density after IA ETX exposure. We speculate that 1,25-(OH)<sub>2</sub>D<sub>3</sub> treatment improves dysregulated angiogenesis in the placenta caused by ETX exposure and can enhance placental function and fetal somatic and lung growth in experimental chorioamnionitis.

Primary Presenter: **Dylan Coughlin**

Project Title: *Patterns of facial trauma before and after legalization of marijuana in Denver, Colorado: A joint study between two Denver hospital*

Primary Mentor: Andrew Winkler

Thematic Area: Public Health and Epidemiology

Abstract:

**Introduction:** The effect of marijuana on human health has been studied extensively. Marijuana intoxication has been shown to affect performance, attention span, and reaction time. The public health relationship between trauma and cannabis use has also been studied, with mixed conclusions. In this report, the effect of marijuana legalization on many aspects of facial trauma at two hospitals in Denver, Colorado is examined.

**Methods:** A retrospective review of the electronic medical records was undertaken. Mann-Whitney U tests were used to compare age of patients before and after legalization, and chi squared analyses were used to compare mechanism of injury, and fracture types before and after recreational marijuana legalization in Denver, Colorado. Geographical location of patients was also considered.

**Results:** No significant increase was found in race before and after marijuana legalization ( $p = 0.19$ ). A significant increase in age was found before ( $M = 39.54$ ,  $SD = 16.37$ ), and after ( $M = 41.38$ ,  $SD = 16.66$ ) legalization ( $p < 0.01$ ). Maxillary and skull base fracture proportions significantly increased following legalization ( $p < 0.001$  and  $p < 0.001$  respectively). No significant differences were seen in the proportion of patients who lived in urban and rural counties before and after legalization ( $p > 0.05$ ).

**Conclusion:** Public health efforts should be directed towards educating residents and visitors of Colorado on the effects and toxicology of marijuana. More epidemiologic studies are needed for further assessment of the long-term effects of the legalization of marijuana on the population.

Primary Presenter: **Gaylan Dascanio**

Project Title: *Health Screening for Internationally Adopted Children: A Systematic Review*

Primary Mentor: Gretchen Domek

Thematic Area: Public Health and Epidemiology

Abstract:

**Background:** Internationally adopted children often experience insufficient medical care, malnutrition, and exposure to toxins and infectious diseases prenatally and in early childhood that pose unique medical issues upon adoption. Early health screening is recommended, but testing often varies, and few evidence-based guidelines exist.

**Objective:** The aim of this systematic review is to report the current status of the medical literature in regard to health screening data for internationally adopted children. Specifically, the reviewers seek to examine the scientific evidence on medical screening for diseases related to environment, nutrition, genetic conditions, infectious diseases, and immunization status of internationally adopted children to determine if current medical screening recommendations are the most evidence-based means of evaluating the health and disease status of these vulnerable children.

**Design/Methods:** Two independent reviewers completed a systematic search following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Databases searched included Ovid MEDLINE, Embase, Cochrane Library, Web of Science, CABI Global Health, SciELO, LILACS, and CINAHL from their inception to July 2015 to identify all English language observational studies that examined disease prevalence (based on laboratory and radiologic analysis) among international adoptees. Reports from the grey literature were also considered. Search strategies were based on the key search concepts of international, child adoption, and health screenings with each concept involving multiple subject headings and text words. Behavior, development, mental health, and disorders based on clinical characteristics (including anthropometrics, physical exam, vision, and hearing) were excluded. Clinical trials, case studies, abstracts, reviews, commentaries, editorials, and letters were not included.

**Results:** The search identified 1,188 records after removal of duplicates. 484 abstracts were reviewed and 209 full-text articles were assessed for eligibility. Of those, 56 articles met the inclusion criteria. Studies meeting eligibility (n=56) assessed disease prevalence of infectious diseases (n=35, 63%), immunization seroprotection (n=9, 16%), endocrine disorders (growth factors and thyroid function) (n=2, 4%), nutrition (iron studies and vitamin D) (n=4, 7%), and environmental pathology (lead exposure) (n=1, 2%). Comprehensive testing assessing multiple areas was done in 9% (n=5) of studies. The most common infections assessed in descending order were tuberculosis, stool studies, hepatitis B, syphilis, HIV, hepatitis C, hepatitis A, and malaria.

**Conclusion:** Evidence on which to base screening protocols for international adoptees is stronger regarding certain infectious diseases and immunizations but is lacking in the areas of environmental, nutritional, and genetic disease risks. Some discrepancies between the evidence available in the literature and current guidelines were revealed, specifically regarding screening for hepatitis A and performing serology to assess seroprotection for previously documented immunizations. Assessing and reassessing the epidemiology of diseases in internationally adopted children is essential to

recommending appropriate medical screening guidelines and keeping these guidelines up-to-date, as prevalent diseases and common countries of origin for internationally adopted children change over time. Additional research is needed in order to propose further steps in the design and validation of a clinical guideline and the practical tools to promote evidence-based medical screening of internationally adopted children.

Primary Presenter: **Tristan Dear**

Project Title: *Post-concussion return-to-learn protocols in school-aged children*

Primary Mentor: Sonja O'Leary

Thematic Area: Public Health and Epidemiology

Abstract:

**Background:** Much research and recommendation has been done in regards to safe management of mild traumatic brain injury (mTBI), also termed a concussion, and returning to play. There is less agreement regarding the best approach to returning to the classroom after a mTBI. This article examines the best current research and recommendations regarding "return-to-learn", then describes steps taken to distribute the summary of current knowledge into an integrated medical and educational treatment team at a large public school system in Denver, CO using a collaborative approach.

**Methods:** A literature review of the most current research on mTBI and return to learn was performed, interviews were conducted with a government lobbyist and a parent advocate and with leaders in mTBI management.

**Results:** Educational material on concussion/mTBI symptomatology and how to optimize recovery was developed and distributed to guardians and educators via School Based Health Centers.

**Conclusion:** Through the development and distribution of educational material, we aim to assist guardians and educators in identifying symptoms of a mTBI that their student may be experiencing, recognize "red flag" symptoms that require immediate attention from a medical team, and most importantly, using this knowledge to optimize reintegration back into the classroom in order to set the student on a path to success.

Primary Presenter: **Nicholas Denardin**

Project Title: *Preventing proximal Adjacent level Kyphosis with strap stabilization*

Primary Mentor: Walter Patel

Thematic Area: Clinical Science

Abstract:

A substantial proportion of patients develop proximal junctional kyphosis following spinal surgery. To combat this postoperative change, several techniques have focused on maintaining the structural integrity of adjacent spinal levels and adapting the proximal end of the fusion construct to accommodate the increased mechanical stressors produced by long spinal fusions. The use of Mersilene Tape (Ethicon, Somerville, New Jersey) for spine and orthopedic surgery is well documented, although considerably less is known about its use for preventing proximal junctional kyphosis. This article describes a proposed technique using Mersilene tape to provide a check-rein strap stabilization at the proximal end of fusion constructs. Initial data suggest that the use of this technique may prevent formation of proximal junctional kyphosis.



Primary Presenter: **Kirk Dressen**

Project Title: *A retrospective, case-control study of the incidence and risk factors of failed spinal blocks for cesarean section*

Primary Mentor: Jason Papazian

Thematic Area: Clinical Science

Abstract:

In this study, we aimed to identify the incidence and predictive factors associated with both complete and partial failed spinal anesthesia for cesarean delivery. The goal is to define the factors associated with a greater likelihood of inadequate intrathecal doses. Both single-shot spinal and combined spinal-epidural anesthesia modalities were investigated. In each technique, 1.5 mL (11.25mg) of 0.75% hyperbaric bupivacaine, 15-25mcg fentanyl, and 125-250mcg preservative-free morphine was used. Our primary hypothesis was that clinical, technical, and obstetric factors contribute to the failure of neuraxial anesthesia for cesarean section. The goal was to characterize the profile of patients requiring its use in order to better identify those who would benefit from the placement of a combined spinal-epidural block over a single-shot technique. Data of parturients were retrospectively studied.

Primary Presenter: **William Dufficy**

Project Title: *Demographic and clinical characteristics of 38 pediatric melanoma patients*

Primary Mentor: William Robinson

Thematic Area: Clinical Science

Abstract:

**BACKGROUND** Pediatric, and particularly prepubertal, melanoma is a rare and poorly characterized disease. In contrast to adults with melanoma, these patients develop their disease without a significant history of sun exposure. This suggests that pediatric melanoma may have a different etiology than its adult counterpart. Epidemiological data demonstrates patterns of incidence in children that are strikingly different from those seen in adults, including male predominance, and increased incidence among non-Caucasian patients, further suggesting that pediatric melanoma is a distinct disease. Early work characterizing its molecular profile may point to dysfunctional DNA repair mechanisms as the driver for oncogenesis, rather than sunlight. **METHODS** This retrospective chart review of melanoma patients under the age of 18 describes the demographic profile, patient and family history, and disease course of 38 patients with conventional and Spitzoid melanoma seen at the University of Colorado Melanoma Clinic. **RESULTS** In this study population, there was a higher frequency of males and non-Caucasians than in adults with melanoma. 27% of pediatric patients with conventional melanoma had a first degree relative with a history of cancer, and 27% had a personal history of multiple dysplastic nevi, compared to 0% and 0%, respectively, among patients with Spitzoid melanoma. Neither Breslow depth nor sentinel lymph node biopsy provided significant prognostic information. **CONCLUSION** Our findings suggest that melanoma arising in childhood and teenage years is a different disease than adult melanoma, and may be more related to predisposing germline molecular variations than sun exposure. Further studies to uncover possible genetic and molecular factors are underway.

Primary Presenter: **Hieu Duong**

Project Title: *Healthcare Workers Perceived Barriers to Providing Contraception Education to Patients in Ho Chi Minh City, Vietnam*

Primary Mentor: Jeanelle Sheeder

Thematic Area: Global Health

Abstract:

**Purpose/Aims:** It is estimated that 40% of all pregnancies in Vietnam are terminated each year, and that of those, two thirds are the result of unwanted pregnancy. The purpose of this study is to create a novel survey to examine barriers that prevent health care providers from educating patients about contraception in Ho Chi Minh City, VN.

**Methods/Study Design:** Qualitative in-depth discussions were completed with health care providers at both a public and private hospital to learn directly about experiences educating patients about contraception, and this information was used to generate a pilot survey. The paper pilot survey was then distributed to 60 health care workers for feedback and for analysis of preliminary data.

**Results:** During 26 in-depth conversational interviews, physicians, nurse-midwives, and pharmacists expressed that lack of time, lack of privacy during patient visit, and lack of patient knowledge were among the top barriers that prevented discussion about contraception with their patients. This information guided creation of a pilot survey, and of 60 pilot surveys distributed at a private hospital. 59 were completed and returned along with feedback.

**Conclusions/Implications:** Health care providers in Ho Chi Minh City, Vietnam experience barriers that hinder education of patients about contraceptives, the most common of which include lack of time and lack of privacy in patient encounters. Identifying barriers that prevent health care providers from educating patients may allow for future targeted interventions to encourage patients to receive confidential and accurate contraceptive education.

Primary Presenter: **Nathaniel Dusto**

Project Title: *Central Visual Oscillopsia: Case Report and Review of the Literature*

Primary Mentor: Benzi Kluger

Thematic Area: Clinical Science

Abstract:

**Objective:**The aim of this study is to present results of an investigation of repetitive Transcranial Magnetic Stimulation (rTMS) applied over primary visual cortex, or area V5/MT, for the treatment of central visual oscillopsia due to traumatic brain injury.

**Presentation of case:** A 57-year old man reported visual oscillopsia following a traumatic brain injury. Symptoms were presumed to be of cortical origin given normal eye movements and eye stability and normal peripheral vestibular function. Furthermore, he reported oscillopsia with visual imagery during eye closure. Occipital lesions damaging white matter connections identified on MRI were suspected to be the cause of the central oscillopsia.

**Review of the literature:**Central oscillopsia, defined as oscillopsia originating from cortical dysfunction, has rarely been reported in the literature. Pathologies associated with oscillopsia in reported cases include neuromyelitis optica spectrum disorder, stroke, migraine without infarction, and psychological trauma.

**Methods:**rTMS was applied in successive rounds of therapy to the left extrastriate visual motion area V5/MT, to bilateral V5/MT, and to bilateral striate visual area V1. The primary outcome measure was dynamic visual acuity. Secondary outcome measures included gaze stabilization testing and subjective improvement as noted by interviews of the patient following each rTMS session.

**Results:**Results from gaze stabilization testing and dynamic visual acuity testing revealed no difference between pre- and post-treatment with rTMS. The patient reported symptomatic improvement in large amplitude oscillations but stated that smaller amplitude oscillations were not affected.

**Conclusions:** The patients reported improvement in large but not small amplitude oscillopsia suggests a treatment effect from rTMS. However, subjective improvement was not reflected in dynamic visual acuity testing results. Further investigation of rTMS as a possible treatment modality for central oscillopsia is warranted, and objective measures of improvement are also needed.

Primary Presenter: **Erica Emmons**

Project Title: *External Validation of a Permanence Calculator: Optimizing Inferior Vena Cava Filter Utilization*

Primary Mentor: Thor Johnson

Thematic Area: Clinical Science

Abstract:

**Purpose:**

Inferior vena cava filters are mechanical devices implanted in patients to help reduce the risk of developing potentially life threatening pulmonary emboli. They come in permanent and retrievable varieties, but there is increased risk to the patient when a retrievable filter becomes permanent. Lack of decision tools to help physicians pick between permanent and retrievable inferior vena cava filters (rIVCF) previously led to the development of a likelihood of permanence calculator. In our study, we aimed to evaluate the performance of this calculator at our institution by validating parameters used by this calculator.

**Methods:**

A prospectively acquired rIVCF database was reviewed from 2011-2015 for all retrievable filters placed; sex, age, history of venous thromboembolism (VTE), presence of malignancy, and presence of neurological disease were collected. Likelihood of filter permanence was calculated using the existing method and compared a) rIVCF declared permanent and b) rIVCF that were removed. We generated estimates of permanence risk for our patient sample and compared these estimates to the permanence calculator estimates.

**Results:**

Of 337 rIVCF devices placed during the study period, 171 (50.7%) were declared permanent. The permanence likelihood, calculated using the permanence calculator, was higher in the permanent group than the removed group ( $p < 0.05$ ). Permanence was significantly underestimated by the permanence calculator ( $p < 0.05$ ) and this underestimation did not vary by permanence status ( $p > 0.05$ ). Our modified algorithm found age (relative risk [RR], 1.01; 95% confidence interval [CI], 1.01-1.02), presence of malignancy (RR, 1.37; CI, 1.11-1.68), presence of neurological disease (RR, 1.56; CI, 1.12-2.16), and an indication of AC failure (RR, 1.74; CI 1.25-2.43) to be the strongest predictors of filter permanence ( $p < 0.05$ ).

**Conclusion:**

The existing calculator estimated higher permanence likelihood for patients with rIVCF declared permanent; however, it consistently underestimated rIVCF permanence likelihood in our population. This study highlights the importance of validating existing decision tools as variations in patient populations and institutional practices may lead to variations in rIVCF permanence risk. When the most appropriate filter for the clinical scenario is chosen, the risk to the patient is reduced, efficiency can be maximized, and cost from complications can be minimized.

Primary Presenter: **Danielle Eves**

Project Title: *Assessment of Barriers That Prevent Healthcare Workers From Providing Contraception Education to Patients in Ho Chi Minh City, Vietnam*

Primary Mentor: Jeanelle Sheeder

Thematic Area: Global Health

Abstract:

**Purpose/Aims:** It is estimated that 40% of all pregnancies in Vietnam are terminated each year, and that of those, two thirds are the result of unwanted pregnancy. The purpose of this study is to create a novel survey examining barriers that prevent health care providers from educating patients about contraception in Ho Chi Minh City, VN.

**Methods/Study Design:** Qualitative in-depth discussions were completed with health care providers at both a public and a private hospital to learn their experiences educating patients about contraception, and this information was used to generate a pilot survey. The paper pilot survey was then distributed to 60 health care workers for feedback and for analysis of preliminary data.

**Results:** During 26 in-depth conversational interviews, physicians, nurse-midwives, and pharmacists expressed that lack of time, lack of privacy during patient visit, and lack of patient knowledge were among the top barriers that prevented discussion about contraception with their patients. This information guided creation of a pilot survey, and of 60 pilot surveys distributed at a private hospital. 58 were completed and returned along with feedback.

**Conclusions/Implications:** Health care providers in Ho Chi Minh City, Vietnam experience barriers that hinder education of patients about contraceptives, the most common of which include lack of time and lack of privacy in patient encounters. Further characterization barriers that prevent health care providers from educating patients may allow for future targeted interventions to encourage patients to receive confidential and accurate contraceptive education.

Primary Presenter: **Christina Farid**

Project Title: *Maternal and Nutritional Influence on Early Intestinal Colonization*

Primary Mentor: Eves Frank

Thematic Area: Basic Biomedical Science

Abstract:

MATERNAL AND NUTRITIONAL INFLUENCE ON EARLY INTESTINAL COLONIZATION Farid C (MD, SOM), Arruda J2, Robbins K1, Ir D3, Robertson C3, Tang M4, Westcott J4, Brumbaugh D1, Krebs N4, Frank DN3. Departments of Pediatrics<sup>1</sup>, Obstetrics and Gynecology<sup>2</sup>, Medicine<sup>3</sup>, and Nutrition<sup>4</sup>. University of Colorado School of Medicine

Initial bacterial colonization of the human intestinal tract is an important process that has numerous implications on human health and disease. Mode of delivery at birth and nutritional habits early in life are two critical determinants of colonization dynamics. We sought to further two studies examining the effects of delivery mode (MOD study) and of supplemental dietary iron (FYI study) on the developing gut microbiome. Fecal samples from participants (n=81) in the FYI study were collected, the DNA was extracted using PowerFecal<sup>®</sup> DNA Isolation Kit (MO BIO Inc), and bacterial 16S rRNA genes (V1V2) were amplified by PCR, sequenced using Illumina MiSeq, and grouped into Operational Taxonomic Units. The comparison of the samples at the four-year time point indicates the intestinal bacterial profiles of the subjects are converging. Further data analysis is needed at this time to completely characterize and compare the microbial makeup of participants in the FYI study. The next step for the MOD study is enrolling expectant mothers. Maternal vaginal and rectal swabs and infant oropharyngeal aspirates and swabs will be obtained and plated on blood and MRS agars in addition to the DNA extraction method described above.

Primary Presenter: **Caitlin Felder-Heim**

Project Title: *Quality of Diabetes and Hypertension Care at the DAWN Student-Run Free Clinic*

Primary Mentor: Cabral Mader

Thematic Area: Public Health and Epidemiology

Abstract:

**Background:** Student-Run Free Clinics (SRFCs) are part of the safety-net healthcare system, but little is known about their quality of care. This study compares diabetes and hypertension care at the DAWN SRFC to Colorado safety-net providers using national standards and establishes quality improvement targets.

**Methods:** Mixed-methods evaluation of diabetes and hypertension management for patients initiating care from March 1, 2015 to September 31, 2016. Retrospective chart review was used to complete quantitative study of disease process measures (screening tests) and intermediate outcomes (disease control). Qualitative in-depth review of randomly-selected well- and poorly-controlled patients helped identify barriers to health and variations in care. Quantitative results were compared to Colorado Medicaid (CoM) using one proportion and paired t-tests.

**Results:** Process outcomes for diabetic patients (n=30) showed: HbA1c 93.3% (vs. 77.8% CoM, p=0.04), nephropathy screening 70% (vs. 85.4% CoM, p=0.02), and retinopathy exam 30% (vs. 40.47% CoM, p=0.24). Diabetic intermediate outcomes showed: 46.7% with good control (vs. 37.3% CoM, p=0.29) and 40% with poor control (vs. 55% CoM, p=0.10).

Hypertensive patients (n=75) experienced an average decrease in systolic blood pressure of 8.66mmHg (p<0.01) and 33.3% (vs. 58.9% CoM, p<0.01) of patients were at blood pressure goal.

**Conclusions:** Despite managing a population with previously minimal access to care and poor disease control, DAWN Clinic diabetes and hypertension outcomes are comparable to Colorado Medicaid except for lower rates of nephropathy screening and blood pressure control. To address these outcomes, quality improvement efforts should include improving follow-up, standardizing documentation, and addressing barriers to care.



Primary Presenter: **Kelly Finnegan**

Project Title: *Patient Perception of HIV Risk versus Actual Risk in Urban Emergency Department Settings: A Secondary Analysis of The HIV TESTED Trial*

Primary Mentor: Jason Haukoos

Thematic Area: Public Health and Epidemiology

Abstract:

**Context:** Of the 1.1 million HIV positive individuals living in the United States in 2018, approximately 14% are unaware of their diagnoses. Certain populations are disproportionately represented in the HIV positive population.

**Objective:** To determine if a relationship exists between patient demographics and their self-reported perceived HIV risk. To determine if co-variants within a patient population would predict an overestimation or underestimation of personal risk of HIV when compared to their calculated Denver HIV Risk Score (DHRS). To evaluate the relationship between self-reported perceived HIV risk and agreeing to an HIV test in the emergency department.

**Design:** Secondary analysis of The HIV TESTED Trial, a multi-center pragmatic randomized trial evaluating three forms of HIV screening in emergency departments.

**Setting:** Denver Health Medical Center (DHMC), Denver, CO; Highland Hospital, Oakland, CA; Johns Hopkins Hospital, Baltimore, MA; and University of Cincinnati Medical Center, Cincinnati, OH.

**Participants:** Clinically stable patients >16 years of age enrolled in The HIV TESTED Trial who completed a risk assessment survey and for whom quantitative HIV risk assessment was determined by the Denver HIV Risk Score.

**Main Outcome Measures:** Perceived and actual HIV risk; HIV testing.

**Results:** A significantly higher perceived risk was found among patients <25 years of age ( $p=0.002$ ), those who have been tested for HIV previously ( $p=0.0004$ ) and those who speak Spanish as their primary language ( $p=0.02$ ). Hispanics ( $p=0.04$ ) and those who have a college degree or higher ( $p=0.03$ ) on average report significantly lower perceived HIV risk. Those <25 years of age ( $p<0.0001$ ) significantly overestimated their HIV risk when compared to their DHRS category. Black patients ( $p= <0.0001$ ) and those between the ages of 25-45 ( $p=0.0002$ ) on average significantly underestimated their risk for HIV. A persons self-perception of their HIV risk was found to be significantly correlated with accepting an HIV test ( $p=0.0005$ ).

**Conclusions:** Several patient demographics are significant predictors in how a patient will view their personal HIV risk, and a higher perceived risk for infection is positively associated with accepting an HIV test. Black patients and those of age 25-35 were found to significantly under-estimate their risk for HIV, and these demographic communities could benefit from further HIV risk education.

Primary Presenter: **Ryan Fitt**

Project Title: *Mistaken for Malignancy: A Case of Pulmonary Mucormycosis*

Primary Mentor: Jeffrey Hollis

Thematic Area: Clinical Science

Abstract:

We report the case of a 59-year-old female with pulmonary mucormycosis. She had a history of poorly controlled Type-II diabetes mellitus and presented to Denver Health with shortness of breath and cough for 2 weeks. She was found to be in DKA, and imaging revealed post-obstructive pneumonia of the right upper lobe. The obstruction was presumed to be malignant, and the patient was set to be discharged after bronchoscopy, with follow up of pathology results as an outpatient. Just before discharge, however, histopathology revealed mucormycosis, rather than malignancy, as the cause of the obstruction. The patient remained in the hospital for an additional 2 months for treatment of pulmonary mucormycosis, which included right upper lobectomy and intravenous amphotericin B. Her post-surgical course was complicated by persistent stenosis of the right main bronchus, for which she underwent laser dilatation therapy. 8 months after discharge, the patient is free of symptoms and maintains improved glycemic control. Pulmonary mucormycosis is associated with extremely high mortality, and timely diagnosis and treatment are keys to survival. Challenges in diagnosing pulmonary mucormycosis include its rarity, mimicry of other, more common diseases, and a lack of specific imaging and laboratory tests. Barriers to successful treatment of pulmonary mucormycosis include a lack of effective therapies. Given the high mortality associated with pulmonary mucormycosis, this case illustrates the importance of maintaining a high index of suspicion for this infection in patients with DKA and post-obstructive pneumonia who have a history of poorly controlled diabetes mellitus.

Primary Presenter: **Robert Flick**

Project Title: *Burden of disease and risk factors for death among children treated for tuberculosis in Malawi*

Primary Mentor: Mina Hosseinipour

Thematic Area: Public Health and Epidemiology

Abstract:

**SETTING:** Tuberculosis (TB) is a leading cause of childhood death. Patient-level data on pediatric TB in Malawi that can be used to guide programmatic interventions are limited.

**OBJECTIVE:** To describe pediatric TB case burden, disease patterns, treatment outcomes, and risk factors for death and poor outcome.

**DESIGN:** We conducted a retrospective cohort study utilizing routine data. Odds ratios (ORs) for factors associated with poor outcome and death were calculated using generalized estimating equations.

**RESULTS:** Children represented 8% (371/4642) of TB diagnoses. The median age was 7 years (interquartile range 2.8–11); 32.8% (113/345) were human immunodeficiency virus (HIV) infected. Of these, 54.0% were on antiretroviral therapy (ART) at the time of anti-tuberculosis treatment (ATT) initiation, 21.2% started ART during ATT, and 24.8% had no documented ART. The treatment success rate was 77.3% (11.2% cured, 66.1% completed treatment), with 22.7% experiencing poor outcomes (9.5% died, 13.2% were lost to follow-up). Being on ART at the time of ATT initiation was associated with increased odds of death compared to beginning ART during treatment (adjusted OR 2.75, 95%CI 1.27–5.96).

**CONCLUSION:** Children represent a small proportion of diagnosed TB cases and experience poor outcomes. Higher odds of death among children already on ART raises concerns over the management of these children. Further discussion of and research into pediatric-specific strategies is required to improve case finding and outcomes.

Primary Presenter: **Greg Fliney**

Project Title: *Neovascular Age-Related Macular Degeneration Disease Quiescence with Visual Acuity Stability in a Sub-Group of Patients Following PRN Treatment*

Primary Mentor: Curtis Hagedorn

Thematic Area: Clinical Science

Abstract:

**Purpose:** This study evaluates long-term visual acuity (VA) outcomes in patients with prolonged clinically quiescent neovascular age-related macular degeneration (AMD) after treatment with a pro re nata (PRN) regimen of anti-vascular endothelial growth factor (VEGF) agents (bevacizumab, ranibizumab, and/or aflibercept).

**Methods:** This retrospective study analyzes VA changes in 105 eyes from 72 patients with a period of AMD disease quiescence (determined by retinal examination) not requiring treatment for at least 180 days. All patients were seen at Colorado Retina Associates between October 31, 2005 and December 31, 2015. VA was measured at the time of first treatment, last treatment, and final clinic visit showing changes in VA during the treatment and quiescent periods. The sample was stratified to compare those with VA gain throughout the study to those with VA loss.

**Results:** The aggregate group showed VA stability during the treatment period (20/117 to 20/116) with a significant decline during the quiescent period (to 20/235;  $p < 0.001$ ). The VA gainers had a significant increase in VA during the treatment period (20/187 to 20/88;  $p < 0.001$ ) and VA stability during the quiescent period (to 20/93). VA losers had a significant decline in VA during both the treatment and quiescent periods ( $p < 0.001$ ).

**Conclusion:** Overall, PRN treatment resulted in a decline in VA during a period of apparent disease quiescence. There is a group of patients that does not lose VA during this period, and if patients like these can be identified, their treatment could be optimized to include a period of clinically justified non-treatment.

Primary Presenter: **Ben Flitter**

Project Title: *A survey of youth with new onset type 1 diabetes: Opportunities to reduce diabetic ketoacidosis*

Primary Mentor: Guy Todd Alonso

Thematic Area: Clinical Science

Abstract:

**Objective:** Pediatric patients in Colorado with new onset type 1 diabetes (T1D) presenting with diabetic ketoacidosis (DKA) increased from 29.9% to 46.2% from 1998 to 2012. The purpose of this study was to compare differences between patients with newly diagnosed T1D who presented in DKA with those who did not across three domains: sociodemographic factors, access to medical care, and medical provider factors, aiming to identify potential targets for intervention.

**Methods:** Sixty-one patients <17 years of age with T1D duration <6 months completed the questionnaire. Groups were compared using Fisher's exact test or the Kruskal-Wallis test. **Results:** Parents of 28% of patients researched their child's symptoms on the Internet prior to diagnosis. At the first healthcare visit for symptoms of T1D, 23% were not diagnosed. There were no significant differences between groups (DKA vs non-DKA) in demographics, first healthcare setting for T1D symptoms, provider type at first visit or at diagnosis, insurance status, or specific barriers to care. DKA patients had a longer interval between previous well visit to diagnosis (median 172 vs 263 days,  $P = 0.01$ ). Non-DKA patients were more likely to have blood glucose measured at  $P = 0.02$ , and had fewer symptoms prior to ( $P = 0.01$ ) the first visit for diabetes symptoms. Parents of non-DKA patients were more likely to be familiar with symptoms of diabetes ( $P < 0.001$ ) and to suspect diabetes ( $P = 0.01$ ).

**Conclusion:** Targets for campaigns to prevent DKA include increasing provider glucose and ketone testing, increasing public knowledge about diabetes, and understanding how sociodemographic factors may delay T1D diagnosis.

Primary Presenter: **Isaac Fonken**

Project Title: *ASSESSMENT OF PEDIATRIC EXPOSURES IN RURAL COLORADO*

Primary Mentor: Kathy James

Thematic Area: Public Health and Epidemiology

Abstract:

**Background:** Prevention and control of environmentally related health concerns is an essential part of public health's role and obligation. Biomonitoring is an established tool to collect data about the regional hazardous exposures. The public health community has called for development, improvement and increased use of biomonitoring capacity (Albertini et al. 2006; CSTE 2013; Hendrick and Farquhar 2010; Paustenbach and Galbraith 2006; Sexton et al. 2004).

**Purpose:** The objective of this research was to characterize environmental exposures in children aged 3-13 years in the San Luis Valley in Central Colorado using concurrently collected urine and water samples. We analyzed urine samples for five a priori selected environmental exposures, including heavy metals, phthalates, 2,4-dichlorophenol (2,4-DCP), 2,5-dichlorophenol (DCP), and pyrethroids and water samples for heavy metals. These toxicants were selected because of the high prevalence of exposure, potential health risk especially in children, and interests by the public health and policy makers. This project was funded by a dedicated grant from the Centers for Disease Control and Prevention (CDC).

**Methods:** We recruited children aged 3-13 years and their parent who are in the patient cohorts of one of the two major San Luis Valley health provider systems and reside in the San Luis Valley, Colorado. We assessed exposure to the five groups of toxicants in biological (urine) samples provided by child participants and potential sources to these exposures through parental surveys and environmental sampling (kitchen tap water). All samples were analyzed at the Colorado Department of Public Health and Environment Chemistry Laboratory for toxicant concentrations and results were mailed to participants. Statistical analysis investigated the association between urinary concentrations of toxicants and potential sources of exposure identified in survey responses and water concentrations. This research was approved by Colorado Institutional Review Board.

**Results:** Children in the San Luis Valley have higher exposure to naturally occurring heavy metals including arsenic, manganese, cadmium, tungsten and uranium than average children of the same age in the US. These exposures are associated with metal concentrations in drinking water. Exposure to 2,4 dichlorophenoxyacetic acid was higher in SLV children especially during the month of May when application to agriculture lands is highest. Exposure to 2,5 dichlorophenoxyacetic acid and phthalates was less than children in the NHANES cohort.

**Conclusions:** Pediatric environmental exposures to naturally occurring metals and agrochemical occurs in the San Luis Valley and, at times, in concentrations greater than the average American child.

Primary Presenter: **Daniel Ford**

Project Title: *Academic Productivity of American Board of Anesthesiology Diplomates from 2006-2016*

Primary Mentor: Karsten Bartels

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Title: Academic Productivity of New American Board of Anesthesiology Diplomates from 2006-2016

Background

Research within the field of anesthesia is crucial to remaining an academically viable specialty. Numerous publications were released in 2006-2007 calling for an increase in academic productivity. The study attempts to classify the academic productivity of new ABA diplomates from 2006-2016 to examine the results of such efforts.

Methods

Lists of new ABA diplomates were obtained from the ABA for years 2006-2016. These names were queried through PubMed, and the number of publications attributed to each diplomate were obtained and recorded. Descriptive statistics were used to compare the number of publications between years.

Results

Academic productivity increased by 47.05% from 2006 to 2016. Linear regression shows the mean number of publications per diplomate increased by 0.0519 per year over the same time period, with an R<sup>2</sup> value of 0.8421. The median number of publications was 0 for all years, but the percentage of diplomates with at least one publication almost doubled from 14.94% in 2006 to 29.29% in 2016.

Conclusions

Academic productivity amongst new ABA diplomates has increased from 2006 to 2016. However, the majority of new diplomates still have no published work at time of primary certification.

Primary Presenter: **Kevin Forey**

Project Title: *Improving clinical outcomes and access to care for the community-based outpatient treatment of acute malnutrition in the pediatric population of Leogane, Haiti: a retrospective cohort study.*

Primary Mentor: Blair Gifford

Thematic Area: Global Health

Abstract:

Background:

In 2010, Childrens Nutrition Program began its community-based management of acute malnutrition (CMAM), aimed at reducing the burden of pediatric malnutrition in Leogane, Haiti, which is estimated to have rates of chronic undernutrition as high as 23.3%.<sup>5</sup> Despite worldwide acceptance and use of CMAM therapy, there is limited discussion of strategies used to improve therapy outcomes in low-resource settings.

Methods:

A retrospective cohort study was conducted on 2 307 children that received CMAM therapy for moderate acute malnutrition (MAM) or severe acute malnutrition (SAM) from 2012 to 2016. All children received Vitamin A, Albendazole, and PlumpyNut supplementation.

Results:

From 2012 to 2016, there were statistically significant improvements in the proportion of children that were Healed from both MAM (N = 528, p = 0.0012) and SAM (N = 417, p = 0.0017) therapy, with a corresponding decrease in Therapy Abandonment. As the age of admission for children enrolling into CMAM therapy increased, fewer children were Healed from MAM therapy (p < 0.001, N = 559). For SAM, however, there was no difference observed (p = 0.5760, N = 425).

Conclusions:

This study offers promising insight for improving CMAM therapy Healing rates through various organizational and strategic efforts.



Primary Presenter: **Kelsey Fowlkes**

Project Title: *Utility and Acceptance of a Clinical Care Guideline for Prevention of Pediatric Hospital-Acquired Venous Thromboembolism*

Primary Mentor: Brian Branchford

Thematic Area: Clinical Science

Abstract:

**Background:** Pediatric hospital-acquired venous thromboembolism (HA-VTE) incidence is increasing but risk factors are not clearly defined. We evaluated A) agreement of risk factor assignment from a bedside HA-VTE prevention clinical care guideline (CCG)-derived risk categorization to that assigned on later EHR audits, and B) adherence to CCG prophylaxis recommendations.

**Methods:** Electronic health records (EHRs) were retrospectively reviewed for 43 children who developed VTE at least 48 h after admission from Aug 2014 to Dec 2015; 35 were identified as high risk. We compared bedside admission risk factor selection, performed in 74% of cases, and daily risk factor assessments, from 83 patient days, to those we identified on later audit to determine accuracy. We also analyzed how often the mechanical (sequential compression boots) and/or chemical (low-dose anticoagulant) prophylaxis recommendations (including hematology consults) in the CCG were followed for patients at high risk for VTE.

**Results:** The bedside admission risk factor selection matched audits in 100% of cases for 6 of 9 risk factors and ranged from 81% to 97% for the remainder. Daily risk factor assignment agreement was also high, except for active infection (76%) and immobility (64%). Immobility risk assignment discordance was eliminated after linkage to the Braden Q mobility score in the EHR. Adherence to CCG-suggested prophylactic interventions, or existence of documented or inferred contraindication, was 63% on the day prior to VTE diagnosis. This is potentially related to an absence of hematology consults in high risk patients outside the ICU.

**Conclusions:** We demonstrate the importance of usable HA-VTE risk factor definitions for proper bedside risk stratification to guide intervention strategies without exposing children to unnecessary thromboprophylaxis. We also show fairly low adherence to intervention suggestions by the risk level algorithm, which may improve after educating providers on the importance of the hematology consult suggested by the CCG.

Primary Presenter: **Jared Fredrickson**

Project Title: *Therapeutic Decisions of Syphilis and Toxoplasmosis Surrounding Pregnancy*

Primary Mentor: Alan Palestine

Thematic Area: Clinical Science

Abstract:

**Purpose:** To assess management differences of syphilis and toxoplasmosis by ophthalmologists and obstetricians surrounding pregnancy.

**Design:** Prospective cross-sectional study

**Methods:** A total of 209 uveitis specialists and approximately 2500 obstetricians across the United States were surveyed using an online questionnaire distributed via listserv and social media posts. Survey respondents were given a series of clinical vignettes containing case examples of a female patient who was either contemplating pregnancy or in the first trimester and was diagnosed with either syphilis or toxoplasmosis. The questionnaire included a total of four case scenarios with questions relating to the management of these diseases; as well as pregnancy counseling.

**Results:** For the syphilis vignette a total of 97 physicians responded to the survey questions. Choices of therapy between physician specialty differed significantly ( $p=0.0001$ ), however pregnancy status did not seem to affect therapy choice in syphilis. A total of 96 physicians responded to the survey questions pertaining to the toxoplasmosis vignette. For a non-pregnant patient diagnosed with toxoplasmosis the differences in therapy choice between specialties were not significant, however when the patient was pregnant therapy choice was significantly different between specialties ( $p=0.0001$ ).

**Conclusions:** There are differences between ophthalmologists and obstetricians when it comes to managing syphilis and toxoplasmosis during pregnancy. It may be worthwhile for specialty societies to collaborate on developing consistent criteria to improve the management of these patients.

Primary Presenter: **Micah Friedman**

Project Title: *Fibromyxoid Variant Nephrogenic Adenoma in a Pediatric Patient: First Report*

Primary Mentor: Damon Olson

Thematic Area: Clinical Science

Abstract:

Nephrogenic adenomas (NA), so named for their histologic similarity to renal tubules, are rare benign lesions of the urothelium. These lesions, which can arise in any portion of the urinary tract, are found most commonly in the bladders of middle-aged men. However, they have been reported in children as young as 3 years old. If symptomatic, patients can present with hematuria, dysuria, and urinary frequency. These lesions had been thought to represent reactive or metaplastic transformation of native urothelial tissue in response to insult. Recent evidence, however, suggests that NA might arise from re-implantation and proliferation of dislodged renal tubular epithelium in areas of damaged downstream tissue. Though NA is not thought to be pre-malignant, it is clinically important to distinguish NA from the range of invasive carcinomas that arise within the urogenital tract and share similar histologic appearance. Histology of NA typically shows small tubular or papillary structures lined by cuboidal to hobnail epithelium. A 2007 case series by Hansel et al introduced a histologically distinct fibromyxoid variant of NA, which demonstrates a predominance of spindle cells within a fibromyxoid matrix. Here we present a case of fibromyxoid NA in a 9-year-old boy. To our knowledge, fibromyxoid NA has not previously been reported in a pediatric patient.

Primary Presenter: **Richard Froude**

Project Title: *Project: Kingdom of Ends: Essays Toward a Poetics of Mortality / Paper: "Form, Measure, and Hybridity in the Life and Work of William Carlos Williams"*

Primary Mentor: Therese Jones

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Kingdom of Ends is a collection of lyric essays that examine the intersections of language, mortality, serious illness, narrative, and poetics. The essays were written over a period of 5 years that spans the author's attendance of medical school at CU, drawing on clinical experiences both during that time and before, including volunteer and clinical research writing and working with terminally ill patients, teaching memoir and nonfiction, and facilitating writing workshops for people with Alzheimer's and their caregivers. The central question of the work is how awareness of our own mortality shapes our language and expression. Following this, the work goes on to discuss the inverse: how our language and expression shape awareness of our own mortality, as well as considering how we might address the impossible in language and how we might say what language cannot say. Three of the essays have been published and one of these - Things To Do In Denver When You're Dead - won the Wabash Prize for Nonfiction from Purdue University and a Stanley Kaplan Essay Prize from the University of Cincinnati's Department of Psychiatry.

Primary Presenter: **Emily Garban**

Project Title: *The Guided Hands: Exploring Self-Identity Through Co-Created Portraits of Adolescents with Epidermolysis Bullosa*

Primary Mentor: Helen Macfarlane

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Children with epidermolysis bullosa (EB) encounter unique issues regarding formation and maintenance of a positive self-identity when confronted with the constant struggles of living with this disease. Teens with EB face an even greater hardship as adolescence brings its own challenges in identity formation, with more potential for conflicts and mental health issues. Art therapy has proven to be an incredibly effective modality for restoring self-identity and confidence among patients. However, traditional art therapy is limited to those who create their own artwork. Studies have hinted at the positive impact co-created artwork can have on patients, but there are very few studies that actually explore the benefits of co-created portraiture as art therapy. Thus, this study aimed to explore the effects of co-created portraiture on the self-identity of adolescents with EB, as well as its ability to expand the benefits of art therapy to a greater number of patients. Serial self-portraits were created with 3 young women with EB over a period of 1.5-2 years. Analysis of the portraits revealed an evolution in the participants self-concept over time, as well as struggles with anxiety, insecurity, and depression. The fact that participants were able to fully engage in artistic expression demonstrates the positive impact of co-creation, and its implications for expanding art therapy to a wider array of patients. The results also suggest that art therapy can serve as an important tool for adolescents with EB, and should be considered in the treatment plan of individuals with this disease.

Primary Presenter: **Andrea Geddes**

Project Title: *Expanded screening criteria for blunt cerebrovascular injury: a bigger impact than anticipated.*

Primary Mentor: Clay Burlew

Thematic Area: Clinical Science

Abstract:

BACKGROUND:

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We implemented expanded screening criteria for blunt cerebrovascular injuries (BCVIs) in an attempt to capture the remaining 20% of patients not historically identified with earlier protocols. We hypothesized that these expanded criteria would capture the additional 20% of BCVI patients not previously identified.

METHODS:

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Screening criteria for BCVI were expanded in 2011 after identifying new injury patterns. The study population included 4years prior (2007 to 2010; classic) and following (2011 to 2014; expanded) implementation of expanded criteria.

RESULTS:

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BCVIs were identified in 386 patients: 150 during the classic period (2.36% incidence) and 236 in the expanded period (2.99% incidence). In the expanded period, 155 patients were imaged based on classic screening criteria, 62 on expanded criteria (21 complex skull fractures, 20 upper rib fractures, 6 mandible fractures, 2 scalp degloving, 1 great vessel injury, and 12 combination), and 19 for other injuries and symptoms.

CONCLUSIONS:

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There was a significant increase in the identification of BCVI following the adoption of expanded screening criteria, resulting in a substantial reduction of missed injuries. Expanded criteria should be adopted when screening for BCVI.

Primary Presenter: **Parsa Ghasem**

Project Title: *Examination of the effects of MerTK inhibition on AML Efferocytosis*

Primary Mentor: Forey Lee-Sherick

Thematic Area: Basic Biomedical Science

Abstract:

Acute Myeloid Leukemia (AML) in the pediatric population continues to be difficult to treat and portend a poor prognosis. Novel therapies are being explored in the realm of activating the body's own immune system to combat AML and malignancies at large. Mer Tyrosine Kinase (MerTK) is present on the vast majority of AML cells and when inhibited causes apoptosis of these malignant cells and improved survival in animal models of malignancy. Recently however it has been suggested that these changes are due to changes in the immune system rather than simply the cytotoxic effects of inhibiting MerTK. We examined the effects of inhibiting MerTK (using pharmacologic and genetic models) on one potential arm of the immune system, efferocytosis. We found no difference in the percentage of efferocytosis of AML Kasumi cells by AML Kasumi cells in vitro.

Primary Presenter: **Ryan Gillum**

Project Title: *Rural vs. Urban Burnout in Primary Care Physicians and the Effects on Implementation of Practice Transformations*

Primary Mentor: Kyle Knierem

Thematic Area: Clinical Science

Abstract:

Abstract Purpose: In the setting of increasing rates of burnout among primary care physicians, new initiatives to incorporate advanced primary care activities into primary care practices have been implemented in practices across the country. This study will determine if patterns and rates of burnout are different between rural primary care physicians and urban primary care physicians and whether higher rates of burnout lead to poorer implementation of advanced primary care activities. Methods: Using data from 211 urban and rural practices participating in the EvidenceNOW Southwest (ENSW) practice transformation project, we looked at burnout among practice members and also used the ENSW Practice Monitor to evaluate how well each of the 211 practices were implementing transformations and if there was any significant difference based on practice setting. Results: There was no correlation between burnout and ENSW practice monitor score. Clinicians in rural and urban primary care practices experienced similar levels of burnout, and rural primary care practice trended toward higher Practice Monitor scores but the difference was not statistically significant. Conclusions: Despite the challenges that rural primary care practices face they tended to have more success in implementation of the building block of high-performing primary care practices. Furthermore, in the face of the unique challenges primary care clinicians face in providing high quality care in rural settings and the risk of professional burnout that comes with those challenges, there may be protective factors against burnout inherent to rural practice.



Primary Presenter: **Jamie Gilroy**

Project Title: *Access to Behavioral Health Care for Insured Coloradans*

Primary Mentor: Vu Seymour

Thematic Area: Clinical Science

Abstract:

The Patient Protection and Affordable Care Act (ACA) mandates that health insurance plans include sufficient access to behavioral health providers, but lacks specific guidelines to define sufficient access. Using a secret shopper methodology, we called behavioral health providers in the Denver metropolitan area networked with 3 large insurance companies. We found that, depending on insurance company and level of training, 9.8% to 59% of providers could offer a new patient appointment, with psychiatry appointments being particularly difficult to schedule. These findings are consistent with similar studies conducted in other regions, suggesting that access to outpatient behavioral health care is limited despite existing ACA regulations.

Primary Presenter: **Matthew Givens**

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

Primary Mentor: David Richards

Thematic Area: Global Health

Abstract:

Background

The clinical outcomes of paediatric patients requiring resuscitation depend on physicians with specialized knowledge, equipment, and resources due to their unique anatomy, physiology, and pathology. Khayelitsha Hospital (KH) is a government hospital located near Cape Town, South Africa, that sees approximately 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 that were treated in the resuscitation area of KH in the six-month period from 1 November 2014 through 30 April 2015.

Results

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

Conclusion

These 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: **Dawn Goral**

Project Title: *Intramedullary Implant Choice and Cost in the Treatment of Pediatric Diaphyseal Forearm Fractures*

Primary Mentor: Austin Heare

Thematic Area: Clinical Science

Abstract:

**Objectives:** The aim of this study was to compare outcomes and costs between titanium elastic nails (TENs), stainless steel elastic nails (SENs), and Kirschner wires (K-wires) in the treatment of pediatric diaphyseal forearm fractures with intramedullary fixation.

**Design:** Retrospective cohort study.

**Setting:** Level 1 Pediatric Trauma Center.

**Patients/Participants:** A total of 100 patients (65 male and 35 female) under 18 years of age with diaphyseal forearm fractures treated with intramedullary fixation were included in the study.

**Intervention:** Patients received single or both bone intramedullary fixation with either TENs, SENs, or K-wires.

**Main Outcome Measurements:** Time to radiographic union, complication rate, surgical time, and average cost per implant.

**Results:** 100 patients were included in the study. 31 patients were treated with TENs, 30 with SENs, and 39 with K-wires. No significant difference in time to radiographic union, complication rate, or surgical time was found between the three types of fixation. Average time to union was 9.4 weeks  $\pm$  5.4 weeks and complication rate was 12.9% for TENs, 10.0% for SENs, and 12.8% for K-wires. There was a significant difference in cost per implant, with an average cost of \$591, \$158 and \$22 for TENs, SENs, and K-wires respectively ( $p < 0.001$ ).

**Conclusions:** The present study demonstrates no difference between TENs, SENs, and K-wires in the treatment of pediatric diaphyseal forearm fractures with regards to outcome, time to union, surgical time or complication rates. Given the significant cost difference between these implants, we recommend surgeons consider modifying their implant selection to help mitigate cost.

**Level of Evidence:** Therapeutic Level III.

Primary Presenter: **Oren Gordon**

Project Title: *How Phenylbutyrate Protects Mitochondria from the Toxic Effects of Hydrogen Peroxide on Membrane Potentials,  $\hat{\pm}$ -Ketoglutarate Dehydrogenase, and ATP Synthase in N27 Dopamine Neurons*

Primary Mentor: Curt Freed

Thematic Area: Clinical Science

Abstract:

While phenylbutyrate has been shown to rescue neurons from oxidative stress by up-regulating the neuroprotective gene DJ-1, the exact mechanism of this protection is uncertain (1). Studies have linked DJ-1 expression to the mitochondrial membrane potential (MMP), but the effects of oxidative stress on the MMP is still unclear (2-6). Literature shows that oxidative stress leads to changes in the MMP, reduced ATP production, and inhibition of the  $\hat{\pm}$ -ketoglutarate dehydrogenase complex, but these findings have never been linked to other studies illustrating  $\hat{\pm}$ -ketoglutarates inhibitory effects on ATP synthase (7-10). In the present study, N27 dopamine neurons were incubated with phenylbutyrate, and then treated with hydrogen peroxide for up to 24 hours. The MMP was measured by staining the cells either with either JC-1 or MitoTracker Red (CMXRos). A metabolomics study was run on these cells using high performance liquid chromatography coupled with mass spectrometry. We found that cells exposed to hydrogen peroxide had decreased cell viability, hyperpolarized MMP, elevated ADP and elevated  $\hat{\pm}$ -ketoglutarate. Cells pretreated with phenylbutyrate were protected from these changes in the MMP, ADP and  $\hat{\pm}$ -ketoglutarate levels and phenylbutyrate alone led to an increase in glutathione levels. These results illustrate a pathway by which oxidative stress leads to a hyperpolarized MMP. We concluded that hydrogen peroxide leads to inhibition of the  $\hat{\pm}$ -ketoglutarate dehydrogenase complex, which leads to an elevated  $\hat{\pm}$ -ketoglutarate concentration, which inhibits ATP synthase and hyperpolarizes the MMP. Phenylbutyrate prevents these changes through elevating glutathione levels and quenching the initial ROS insult from hydrogen peroxide.

Primary Presenter: **Kathryn Guinn**

Project Title: *The satisfied rural physician: a systematized review*

Primary Mentor: Rita Lee

Thematic Area: Public Health and Epidemiology

Abstract:

Abstract:

**OBJECTIVES/AIM:** To evaluate and synthesize evidence on the factors which contribute to job satisfaction and resiliency in rural primary care physicians.

**BACKGROUND:** Unique demands and challenges exist for primary care providers in rural settings that have been associated with increased levels of burnout, stress, and dissatisfaction. Rural areas have more severe primary care physician shortages than urban areas and struggle with physician job retention. Satisfaction and resiliency have been shown to increase job retention in rural areas. Factors associated with resilience and satisfaction have not been systematically evaluated in the rural primary care setting.

**STUDY DESIGN:** Systematized review

**METHODS:** Pubmed, Embase, and PsychINFO were searched to determine research on this topic. Texts selections were conducted by one reviewer based on eligibility criteria and data was extracted on factors associated with primary care physician resilience and satisfaction in a rural setting.

**RESULTS AND CONCLUSION:** Five studies met inclusion criteria on satisfaction. No studies were identified which looked at resiliency rural primary care physicians. Limitations to methodology include only including texts which were in English and published. In addition, only one reviewer screened and assessed texts to include in systematized review. Characteristics and factors which were associated with higher levels of satisfaction include: appropriate workload, limited number of on-call shifts, sense of personal accomplishment, ability to obtain furthering professional and medical education, income, and lack of stress and mental illness. No articles were found which studied resiliency in exclusively rural primary care populations.

Primary Presenter: Sarah Ha

Project Title: *A Strategy to Reduce Health Inequities: The Colorado Medical-Legal Partnership*

Primary Mentor: Angela Sauaia

Thematic Area: Public Health and Epidemiology

Abstract:

### Background

Medical-Legal Partnerships (MLP) have emerged as a promising initiative to address health inequities. We describe the preliminary evaluation of the MLP-Colorado, initiated in 2014 at a Federally Qualified Health Center (*Salud* Family Health Centers) to determine whether this program of addressing health inequities directly improves health outcomes for patients.

### Methods

The legal team addresses I-HELP: (Income/Benefits, Housing/Utilities, Education, Legal Status/Immigration, Personal/Family Stability/Safety) issues. The four-pronged evaluation includes: 1) legal outcomes; 2) health outcomes (SF-36 physical/mental health summary measures); 3) cost/resource utilization (benefit enrollment, no-shows decrease, ER visits, hospitalizations); 4) client satisfaction. The first 19 clients were interviewed once within 6 months of the first legal consult. For the subsequent cohort of 44 clients, we conducted baseline (first MLP-CO consult) and follow-up (6 months or at case closing) interviews.

### Results

We present here the results of the first 19 clients. I-HELP needs were: 41% Income, 18% Housing, 0% Education, 47% Legal status, 12% Personal (1 client had > 1 need). After 6 months of the first MLP-CO consult, 71% and 59% of clients, indicated “much or somewhat better” physical and mental health. During this period, they reported a decrease in: ER visits (76%), hospitalizations (65%), missed medical appointments (76%), and missed work days (47%). Overall, 65% attributed a “great/moderate” health improvement to their relationship with the MLP-CO. Eight cases were closed, mostly related to immigration and benefits. Despite the justice system slowness, client satisfaction with MLP was high, with 88% rating it as 4-5 (5 = best).

### Conclusion

Integrating legal assistance into healthcare may decrease health inequities. The subsequent cohort’s evaluation will provide a more rigorous assessment.

Primary Presenter: **Bruce Han**

Project Title: *The Game Changer: A Hamilton Arrangement about medical student mental health*

Primary Mentor: Jennifer Reese

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Mental health in medical education has received a significant amount of attention in the past decade, as we are continually become more aware of the mental and emotional implications of our current medical education system. However, even with the push for better awareness of resilience, medical student and resident burnout still remains a significant issue with an alarming percentage of students reporting depression or suicidal thoughts. Even though resources addressing this issue are increasing on a national level, there remains a significant stigma behind seeking out counseling or help. Acknowledging the severity of burnout and accepting support towards resilience is unfortunately thought of as weaknesses in a world which rewards the image of perfection, which in turn leads to trainees to not seek help. *Hamilton: An American Musical*, created by Lin-Manuel Miranda, is an original Broadway musical that incorporates hip-hop, rap, and soul music into telling a compelling origin story about Alexander Hamilton, one of the Founding Fathers of the United States of America. By transposing songs taken from the original soundtrack, arranging the musical score, playing and recording the instrumentals, and writing lyrics based on my own experiences with resilience, I aim to destigmatize mental health in medical education. The ultimate goal of this project is to provide an easily distributable and relatable music video that emphasizes to the medical education community that we, as medical trainees, are not alone in this struggle against mental health.

Primary Presenter: **Justin Hellwinkel**

Project Title: *Helmet Heads: Promoting Helmet Education and Use in Colorado Public Schools*

Primary Mentor: Jackie Glover

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Background

Head trauma in children is a major cause of preventable morbidity and mortality. Annually, 250 deaths and 140,000 head injuries are caused by bicycle-related injuries in children.<sup>1</sup> Studies evaluating barriers to helmet use and efficacy of legislation on behavioral change reveal low socioeconomic status has been consistency associated with lack of helmet use.<sup>2,3</sup> The most promising methods of ensuring long-term helmet use are education to school age children, provision of helmets, and peer helmet use in this population.<sup>1,4</sup><sup>8</sup> The goal of this study is to encourage helmet use through education and provision of helmets.

Methods

As director of operations and current President of the Board of the local nonprofit organization Helmet Heads, I utilized interactive demonstration, engaging discussion, and helmet donation to promote use in second grade students enrolled in Title 1 schools in the Denver-Metro area. The program was improved from previous years to enhance engaging discussion between students and educators and the curriculum was made more flexible to accommodate learning environments. The program targeted new schools and revisited those from previous years to solidify the importance of helmet use each year to a new cohort of students. Additional funding and creation of an operations manual would be developed to promote future expansion to more remote regions of Colorado.

Conclusions

The curriculum reach was increase from 360 to 900 students annually. Elementary schools targeted for the intervention in previous years were revisited and four additional locations were added. The program was expanded outside of elementary schools to include nonprofit organizations supporting disadvantaged children in Denver. New relationships were fostered with additional local nonprofit organizations and a \$20,000 grant was awarded by the Colorado Department of Human Services for future interventions. Additionally, a digital operations manual was developed for satellite locations to administer the curriculum. Providing the resources and materials for safe play in vulnerable populations allows the opportunity for these students to decrease the rate of preventable head injuries and to act as role models for their peers to change the culture of helmet use.



Primary Presenter: **Jason Hendrickson**

Project Title: *Modulation of inflammatory arthritis by gut microbiota through mucosal inflammation and autoantibody generation*

Primary Mentor:

Thematic Area: Clinical Science

Abstract:

**Objective:** Observations of microbial dysbiosis in patients with RA have raised interest in studying microbial-mucosal interactions as a potential trigger of RA. Using the murine collagen-induced arthritis (CIA) model, we hypothesized that microbiota modulate immune responses leading to autoimmune arthritis.

**Methods:** CIA was induced by immunization of mice with type II collagen (CII) in adjuvant on days 0 and 21, with arthritis appearing at days 23-24. Intestinal microbiota were profiled by 16S rRNA sequencing every 7 days during the course of CIA, and intestinal mucosal changes evaluated on days 14 and 35. Then, microbiota were depleted either in early (7 days preceding) or late (after day 21) CIA by administration of broad spectrum antibiotics. Disease severity, autoantibody and systemic cytokine production, and intestinal mucosal responses were monitored in the setting of microbial reduction.

**Results:** Significant dysbiosis and mucosal inflammation occurred early in CIA, prior to visible arthritis, and continued to evolve during the course of disease. Depletion of the microbiota prior to the induction of CIA resulted in ~40% reduction in disease severity and significantly reduced serum inflammatory cytokines and anti-CII antibodies. In intestinal tissue, IL-17A and IL-22 production were delayed. Unexpectedly, microbial depletion during the late phase of CIA resulted in >90% decrease in disease severity. Anti-CII antibodies were mildly reduced, but significantly impaired in their ability to activate complement.

**Conclusions:** These data support a model in which intestinal dysbiosis triggers mucosal immune responses that stimulate T and B cells that are key for the development of inflammatory arthritis.

Primary Presenter: **Patrick Henthorn**

Project Title: *Influence of Gelatin-Thrombin Matrix Tissue Sealant on Bacterial Colony Formation and Risk of Pelvic Infection*

Primary Mentor: Kian Behbakht

Thematic Area: Basic Biomedical Science

Abstract:

OBJECTIVE:

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Gelatin-thrombin matrix (GTM) tissue sealant use was previously identified as an independent predictor of pelvic infection following hysterectomies. We aim to elucidate contributing factors by assessing influence of GTM on bacterial colony formation and characterizing bacteria present at the vaginal cuff.

METHODS:

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Escherichia coli was incubated in phosphate-buffered saline (PBS) and pelvic washings with and without GTM to assess influence on colony formation. Pelvic washings of the vaginal cuff were collected from hysterectomies occurring from June through October 2015. In vitro techniques, 16S rRNA gene qPCR, and 16S amplicon sequencing were performed with washings to characterize bacteria at the vaginal cuff.

RESULTS:

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Mean bacterial colony formation in PBS was greater for E. coli incubated in the presence of GTM ( $1.48 \times 10^7$  CFU/mL) versus without ( $9.95 \times 10^5$  CFU/mL) following 20-hour incubation ( $p = 0.001$ ). Out of 61 pelvic washings samples, 3 were culture positive ( $\geq 5000$  CFU/mL) with Enterococcus faecalis.

CONCLUSION:

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In vitro experiments support a facilitating role of GTM on colony formation of E. coli in PBS. However, given the negative results of surgical site washings following adequate disinfection, the role of GTM in promoting posthysterectomy pelvic infections may be limited. Analysis of pelvic washings revealed presence of E. faecalis, but results were inconclusive. Further studies are recommended.

Primary Presenter: **Lindsey Herrera**

Project Title: *A Pre-Health Mentorship Program to Alleviate Physician Shortages in Colorado Springs*

Primary Mentor: John Frerichs

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

The University of Colorado School of Medicine opened a new branch campus in 2016 in the underserved city of Colorado Springs, in partnership with the undergraduate campus University of Colorado-Colorado Springs (UCCS). With the formation of this partnership, medical students from the University of Colorado School of Medicine developed an advising and mentorship program for the UCCS prehealth undergraduate students. Undergraduate students identified their areas of advising need, which predominantly included finding relevant work experiences, shadowing opportunities, MCAT preparations, and general advice regarding the general process of applying to medical school. Medical students were able to provide counseling on over eighty percent of the areas of need identified over the first phase of the program. Long term aims of the project are to retain pre-health students in the Colorado Springs community, as well as to improve diversity in the University of Colorado School of Medicine student body. Long term follow up will be needed to measure these future goals.

Primary Presenter: **Julie Highland**

Project Title: *Patient satisfaction with student-trained Spanish interpreters: A model for interpreter services at student-run free clinics.*

Primary Mentor: Steven Lowenstein

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

### Introduction

The DAWN (Dedicated to Addressing Aurora's Needs) Clinic is a student-run free clinic (SRFC) that provides health care to many Spanish-speaking residents of Aurora, Colorado. However, DAWN has a shortage of trained bilingual staff and often relies on "impromptu" interpreters, including family members or untrained healthcare professionals. We designed a Spanish interpreter course to help remedy this shortage.

### Methods

The interpreter training course, designed by a second-year medical student (a certified Spanish interpreter) was offered to health professions students beginning in 2015. The 6-week course, which adhered to the National Council on Interpreting in Health Care standards, included lectures, interactive workshops, simulations and supervised clinical interpreting experiences with trained interpreters.

The course evaluation included two components. First, a survey was designed to measure learners confidence in interpreting and language skills across three domains (Spanish language skills, interpreting skills and knowledge of obstacles faced by Spanish-speaking patients). A second survey, distributed to DAWN clinic patients over a 2-year period, included measurements of ease of understanding and patient satisfaction with provider communication. In both surveys, mean Likert scale scores were compared using ANOVA.

### Results

Students reported significantly increased confidence in interpreting and Spanish language skills after completing the course. Spanish-speaking patients reported high levels of satisfaction with their interpreters and understanding of medical information, with scores equal to those of English-speaking patients.

### Discussion

This student-taught course enables health professions students with advanced Spanish language skills to improve their ability to interpret and contribute positively to patient care at a SRFC.

Primary Presenter: **Mary Hill**

Project Title: *Recent Trends in Disease Severity and Quality of Life Instruments for Atopic Dermatitis: A Systematic Review*

Primary Mentor: Cory Dunnick, MD

Thematic Area: Clinical Science

Abstract:

Recent Trends in Disease Severity and Quality of Life Instruments for Atopic Dermatitis: A Systematic Review

Mary K. Hill, BA1; Azin Kheirandish Pishkenari, BA1; Taylor L. Braunberger, MD2; April W. Armstrong, MD, MPH3; Cory A. Dunnick, MD4,5

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5Dermatology Service, U.S. Department of Veterans Affairs, Eastern Colorado Health Care System, Denver, Colorado.

**Introduction:** A significant number of instruments exist aimed at quantifying atopic dermatitis (AD) outcomes. To our knowledge, no systematic review has described trends in the use of outcomes measures by AD studies published since July 2010. The purpose of this study was to assess by systematic review recent trends in disease severity and quality of life (QoL) outcomes instruments used in randomized controlled trials (RCTs) on AD between July 2010 and July 2015.

**Methods:** A total of 540 non-duplicate records were identified through searches of Ovid MEDLINE and Scopus. Included studies were RCTs on AD in humans published in English between July 2010 and July 2015 that reported the results of disease severity and/or QoL outcomes measures.

**Results:** All of the 135 included studies reported disease severity outcomes, while only 45 studies assessed QoL. Among the 135 included studies, a total of 62 disease severity scales and 28 QoL measures were identified. The most frequently used disease severity measures were the Scoring Atopic Dermatitis tool followed by the Visual Analogue Scale for pruritus, which were employed by 79 RCTs (59%) and 30 RCTs (22%), respectively. The most common QoL instrument, the Dermatology Life Quality Index, was used in 20 of the 135 RCTs (15%), whereas the next most common measure, the Infants Dermatology Quality of Life Index, was used in only eight RCTs (6%).

**Conclusion:** Disease severity and QoL outcomes measures are instrumental in evaluating AD treatment efficacy. The number of such tools used in RCTs on AD continues to rise. Standardization of outcomes instruments is essential for comparability among studies and improved quality of evidence.

Primary Presenter: **My-Linh Ho**

Project Title: *Anti-citrullinated protein antibodies are associated with neutrophil extracellular traps in the sputum in relatives of rheumatoid arthritis patients*

Primary Mentor: Givens Demoruelle

Thematic Area: Basic Biomedical Science

Abstract:

**Objectives:** Studies suggest that rheumatoid arthritis (RA)-related autoimmunity is initiated at a mucosal site. However, the factors associated with the mucosal generation of this autoimmunity are unknown, especially in individuals who are at-risk for future RA. Therefore, we tested anti-cyclic citrullinated peptide (anti-CCP) antibodies in the sputum of RA-free first-degree relatives (FDRs) of RA patients and patients with classifiable RA.

**Methods:** We evaluated induced sputum and serum from 67 FDRs and 20 RA subjects for anti-CCP-IgA and anti-CCP-IgG, with cut-off levels for positivity determined in a control population. Sputum was also evaluated for cell counts, neutrophil extracellular traps (NETs) using sandwich ELISAs for protein/nucleic acid complexes, and total citrulline.

**Results:** Sputum anti-CCP-IgA and/or anti-CCP-IgG was positive in 17/67 (25%) FDRs and 14/20 (70%) RA subjects, including a portion of FDRs who were serum anti-CCP negative. In FDRs, elevations of sputum anti-CCP-IgA and anti-CCP-IgG were associated with elevated sputum cell counts and levels of NET complexes. Anti-CCP-IgA was associated with ever-smoking and elevated sputum citrulline levels.

**Conclusions:** Anti-CCP is elevated in the sputum of FDRs, including seronegative FDRs, suggesting the lung may be one site of anti-CCP generation in this population. The association of anti-CCP with elevated cell counts and NET levels in FDRs supports a hypothesis that local airway inflammation and NET formation may drive anti-CCP production in the lung and may promote the early stages of RA development. Longitudinal studies are needed to follow the evolution of these processes relative to the development of systemic autoimmunity and articular RA.

Primary Presenter: **Justin Holmes**

Project Title: *Mitigating Healthcare Spending Waste: Cost and Utilization of Magnetic Resonance Imaging in Colorado*

Primary Mentor: Christine Gilroy

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

**Background:** Magnetic Resonance Imaging (MRI) represents a significant contributor to healthcare spending waste in the United States, primarily due to overutilization and pricing failures. The rate of MRI utilization in the U.S. is double that of other industrialized nations; literature demonstrates that overutilization is mostly related to non-adherence to practice guidelines and results in considerable costs. In addition to overutilization, pricing failures remain rampant in the U.S., and MRI pricing is no exception. Previous research has highlighted the variability of pricing variation in the U.S., though few efforts have been made to analyze insurance claims data.

**Methods:** This study is a retrospective analysis of claims data from Colorado HealthOP, a non-profit health insurance company. 1,085 claims for MRI procedures from 1/1/2014 to 2/11/2015 were extracted from the company claims database and categorized according to Current Procedural Terminology (CPT) code. Amounts billed and allowed for each imaging provider were analyzed.

**Results:** The mean and standard deviation for MRI amounts allowed for cervical spine, lumbar spine, upper extremity, and lower extremity, in stated order, are the following: \$1,248.88  $\pm$  \$1,022.66, \$1,428.66  $\pm$  \$1,033.91, \$835.88  $\pm$  \$622.87, and \$987.63  $\pm$  \$674.20. The large standard deviations reflect the five-fold to ten-fold variation in costs.

**Conclusions:** Analysis of insurance claims data from Colorado HealthOP demonstrates the drastic variability of costs in Colorado. Additional utilization and geographic analyses of claims data, increased price transparency, and efforts to target utilization are warranted.

Primary Presenter: **Logan Hostetter**

Project Title: *Is Thioredoxin Interacting Protein a Tumor Suppressor in Anaplastic Thyroid Cancer*

Primary Mentor: Kim Haugen

Thematic Area: Basic Biomedical Science

Abstract:

**Background:** Thioredoxin interacting protein (TXNIP) is expressed in differentiated thyroid cancer (DTC) and is low to absent in anaplastic thyroid cancer (ATC). We hypothesized that TXNIP is a tumor suppressor in thyroid cancer and loss will transform DTC into poorly-differentiated thyroid cancer (PDTC) or ATC.

**Methods:** CRISPR-Cas-9-mediated genome editing was utilized to knock-out (KO) TXNIP in TPC-1, a DTC cell line. TPC-1 TXNIP-KO cells were injected into the flanks of nude mice to analyze tumor growth. Breeding TPO-Cre, LSL-BrafV600E mice with TXNIP fl/fl mice generated mice with papillary thyroid cancer (PTC) harboring BRAFV600E with either TXNIP-KO or wild-type (WT). Mouse weight, thyroid tumor weight, serum thyroxine, and TXNIP RNA were measured at twelve weeks of age, and compared between BrafV600E/TXNIP-KO mice and their BrafV600E littermates. Lungs were analyzed for thyroid metastasis utilizing qRT-PCR for PAX-8, an indicator of thyroid tissue.

**Results:** Lack of TXNIP expression was confirmed by western blot in TXNIP-KO TPC-1 cells. TPC-1 TXNIP-KO cells did not generate tumors in nude mice after twelve weeks. Transgenic BrafV600E (n=19) and BrafV600E/TXNIP-KO (n=25) littermates were followed for twelve weeks, and mouse growth rates were similar in the two groups. T4 levels were similar in TXNIP-WT mice (without BrafV600E) compared to TXNIP-KO, suggesting loss of TXNIP does not alter thyroid development or function. There was no difference in thyroid tumor weight at twelve weeks between the two groups. 63% of the BrafV600E and 64% of the BrafV600E/TXNIP-KO mice had extrathyroid extension of the tumor, and there was no histologic evidence of PDTC, or gross lymph node involvement in either group. One of eight mouse lungs were positive for PAX8 via qRT-PCR, but lung metastases were not identified on histologic examination.

**Conclusions:** We have previously shown TXNIP is associated with DTC (high levels) and ATC (low levels) and may be a tumor suppressor. These experiments show this association does not appear to be causative and in isolation, TXNIP is not a tumor suppressor in a BrafV600E mouse model. This does not exclude TXNIP as a tumor suppressor in other thyroid cancer models (Ras, PIK3CA, Pten).



Primary Presenter: Long Hua

Project Title: *CT-guided Percutaneous Needle Biopsy of Small ( $\leq 10$  mm) Lung Nodules: Accuracy and Complications*

Primary Mentor: Kimi Kondo

Thematic Area: Clinical Science

Abstract:

Introduction: Computed Tomography (CT) guided percutaneous needle biopsy of lung nodules is a common tissue sampling procedure for molecular testing.

Fewer studies investigated diagnostic accuracy and complication rate of this approach when the nodules were small ( $\leq 10$  mm).

Purpose:

The purpose of this study was to determine the diagnostic accuracy and complication rates of CT-guided percutaneous needle biopsy of small lung nodules ( $\leq 10$  mm).

Material and Methods:

An IRB approved retrospective cohort study of patients who underwent CT-guided percutaneous needle (FNA, core, or both) lung biopsies performed between July 2009 and May 2015. Data were extracted from electronic medical records. An exact binomial test was used to test if the proportion of patients experiencing pneumothorax as a complication differed from the proportion of 45% reported in the literature. To evaluate factors associated with accuracy and complications we used general linear models to calculate adjusted relative risk (RR). Using pathology/cytology results as the gold standard, we calculated sensitivity, specificity, accuracy and area under the curve (AUC) for CT guided lung biopsy.

Results:

41 patients (20 female, 21 male; mean age, 62; range: 23 - 88) were identified who had lesions  $\leq 10$  mm. Adequacy for diagnosis was 100%. CT-guided biopsy for diagnosis had a sensitivity of 78.6% (95% CI: 71.5 - 91.7), accuracy of 84.6% and area under the curve of 89.3%. Subpleural ( $\leq 10$  mm from pleural surface) location was the only significant covariate that lowered accuracy (RR: 0.74, 95% CI: 0.58 - 0.94).

44% of patients experienced at least one complication. The most prevalent complication was pneumothorax (39%, 95% CI: 24.2% - 55.5%) with 14.6% of patients requiring chest tube placement. Older patients (RR: 1.03;  $p=0.02$ ) and females (RR: 2.37;  $p=0.04$ ) had higher risk of pneumothorax. In contrast, subpleural location had a protective effect with a RR 0.40 (95% CI: 0.20 - 0.80) compared to other locations ( $p=0.01$ ). A higher number of specimens obtained also showed modest protective effect against pneumothorax. Only 1 patient (2.4 %) had hemothorax and no patients died as a result of percutaneous biopsy.

Conclusion:

CT-guided percutaneous needle biopsy of small ( $\leq 10$  mm) lung nodules can yield a high accuracy rate approaching those of larger lesions without an increased complication rate.

Primary Presenter: **Marissa Hughbanks**

Project Title: *Variable Expression of Estrogen Receptors in Human Articular Cartilage*

Primary Mentor: Myers Burger-Van der Walt

Thematic Area: Basic Biomedical Science

Abstract:

The relationship of estrogen to the degenerative process was proposed in 1925 when the observation was made that there was an increased incidence of osteoarthritis in postmenopausal women. However, the role of estrogen and estrogen receptors in the maintenance of articular cartilage is not well understood; in fact, there is no literature regarding the quantity of estrogen receptors in healthy articular cartilage, or whether the number of receptors changes with age, cartilage degeneration, or sex hormone status.

We hypothesize a correlation between estrogen receptor expression in human articular cartilage and the etiology and severity of osteoarthritis; specifically, an increase in the quantity of estrogen receptors seen in cartilage from patients with (1) radiographic evidence of osteoarthritis, (2) increasing age, and (3) decreasing plasma estradiol and progesterone levels.

To address this question, cartilage samples were obtained from females in the age range of 18-85 who were undergoing knee arthroscopy for ACL reconstruction (control tissue) or total knee replacement surgery (case tissue). Samples were then processed and semi-quantitatively evaluated using immunohistochemistry and histology. Severity of OA was determined using knee radiographs.

This study found (results pending).

Primary Presenter: **Aubrae Isenhart**

Project Title: *Engaging Teens in Weight Management Conversations: A Qualitative Community-Based Participatory Research Study*

Primary Mentor: Janet Meredith

Thematic Area: Public Health and Epidemiology

Abstract:

Engaging Teens in Weight Management Conversations:

A Qualitative Community-Based Participatory Research Study

Background and Objectives:

Childhood obesity is an ever-growing health epidemic in the United States, with rates tripling over the past few decades and a disproportionate burden found in neighborhoods surrounding the University of Colorado Anschutz Medical Campus in Aurora.<sup>1, 8,13</sup> In order to address this rising health concern, this research team studied the experiences of teens and providers who had weight management conversations in a clinical setting using focus groups and a survey. The aim of this study is to elicit teenager-approved methods for discussing and managing weight, to elicit provider perspectives about this issue, and to ultimately improve health outcomes in the community and beyond. The direct input from teenagers makes this project novel, with equivalent studies lacking this element.

Methods:

This study was performed via community-based participatory research (CBPR), in which research design, implementation, and analysis was accomplished with the direct involvement of a teenager advisory board (TAB). A focus group protocol was created, then teenagers were recruited from local schools to participate in focus groups. During these focus groups, the teens shared their experiences regarding weight management conversations with healthcare providers and made suggestions for improvements. Focus groups were audio-recorded, transcribed, then qualitatively analyzed using open coding by three separate coders. Then, electronic and paper surveys were distributed to local healthcare providers regarding their experiences discussing weight with teenage patients. The protocol was IRB exempt: 13-1670.

Results:

Two separate sets of gender-separated focus groups have been conducted and analyzed. The first consisted of Latina/Latino teens and the second of mixed race teens. All participating teens believed it was important for health care providers to understand how to conduct weight management conversations with their teenage patients and most had had experiences with such conversations in the past. The following five main themes were derived from both focus groups: 1) make opening the conversation more comfortable by first getting to know the teenager, 2) discover the teens individual goals and motivations for health and weight loss in order to better tailor advice, 3) provide a written weight management plan composed of a few steps at a time which include concrete and individualized suggestions, 4) provide realistic expectations for weight loss, and 5) support teens with frequent follow

up and verbal encouragement. The provider survey has been disseminated and analyzation is in progress.

**Conclusions:**

While teens agree that the conversations they have with their health care providers are a very important part of their weight management journey, they have many ideas for how these can be improved. Next steps include analyzation of the provider survey, further focus groups and/or surveys to increase the power of our study, and dissemination of the information we have learned to improve health outcomes.

Primary Presenter: **Cecelia Johnson-Sasso**

Project Title: *Marijuana Use and Short-Term Outcomes in Patients Hospitalized for Acute Myocardial Infarction*

Primary Mentor: Lori Walker

Thematic Area: Public Health and Epidemiology

Abstract:

Background: Marijuana use is increasing worldwide, and it is increasingly likely that patients presenting with acute myocardial infarctions (AMI) will be marijuana users. Accordingly, we compared in-hospital outcomes of AMI patients with reported marijuana use to those with no reported marijuana use.

Methods and Results: Hospital records from 8 states between 1994-2013 were screened for patients with a diagnosis of AMI. Clinical profiles and outcomes in patients with reported use of marijuana were compared to patients without reported marijuana use. Short-term outcomes were defined as adverse events that occurred during hospitalization for an admitting diagnosis of AMI International Classification of Diseases-9 Clinical Modification [ICD-9 CM] code 410.xx). Patients <18, >70 years old or those who used cocaine, methamphetamine, or alcohol were excluded from the primary study population. The composite primary outcome included in-hospital death, intraaortic balloon pump placement, (IABP), mechanical ventilation, cardiac arrest, and shock. In total, 3,854 of 1,273,897 AMI patients reported use of marijuana. In multivariate analysis including age, race and cardiac risk factors, there was no association between marijuana use and the primary outcome ( $p=0.53$ ). However, in-hospital mortality was lower in marijuana-using patients (OR 0.79,  $p=0.016$ ), less likely to experience shock (OR 0.74,  $p=0.001$ ), or require an IABP (OR 0.80,  $p=0.03$ ) post AMI. Marijuana users were more likely to be placed on mechanical ventilation (OR 1.19,  $p=0.004$ ).

Conclusions: Marijuana use was not associated with increased risk of the primary outcome, but was associated with decreased in-hospital mortality post-AMI. This could be due to the younger age of marijuana users in the population analyzed. Further investigation is necessary to understand these findings.

Primary Presenter: **Katia Johnston**

Project Title: *Case Series of Brown Sequard Syndrome*

Primary Mentor: Sean Donahue

Thematic Area: Clinical Science

Abstract:

**Background:** This case series describes two cases of Brown Sequard Syndrome. This is a rare syndrome, and not many cases have been described, especially in the emergency setting. The comparison of these two cases will help contribute to our knowledge of these syndromes, their manifestations in the acute setting, and how to appropriately diagnose and care for them in the emergency department.

**Cases:** Case 1 is a 66-year-old African-American female who presents with right-sided weakness as well as loss of proprioception on the right side and loss of pain/temperature sensation on the left side after sustaining a stab wound to the neck. Case 2 is a 51-year-old male with weakness and loss of proprioception of his right lower extremity and loss of pain sensation in the left lower extremity after being stabbed with a screwdriver in the thoracic spine area.

**Conclusions:** These are two cases that describe the rare Brown Sequard Syndrome after stabbings. Case one involves the cervical spine while case two involves the thoracic spine. Both patients demonstrate the pathophysiology of the syndrome by displaying ipsilateral loss of motor function, proprioception, and vibration below the level of the lesion and contralateral loss of pain/temperature sensation beginning about two levels below the lesion. Knowing the characteristics of Brown Sequard Syndrome that are exemplified by these two cases in our emergency department can help predict patient prognosis and recovery, as well as exemplify appropriate treatment strategies, and is an important first step in the care for such patients.

Primary Presenter: **Wallace (Ned) Jones**

Project Title: *Developing Mobile Clinical Decision Support for Nursing Home Staff Assessment of Urinary Tract Infection using Goal-Directed Design*

Primary Mentor: Heidi Wald

Thematic Area: Clinical Science

Abstract:

**Background:** Unique characteristics of nursing homes (NHs) contribute to high rates of inappropriate antibiotic use for asymptomatic bacteriuria (ASB), a benign condition. A mobile clinical decision support system (CDSS) may support NH staff in differentiating urinary tract infections (UTI) from ASB and reducing antibiotic days.

**Objectives:** We used Goal-Directed Design to: 1) Characterize information needs for UTI identification and management in NHs; 2) Develop UTI Decide, a mobile CDSS prototype informed by personas and scenarios of use constructed from AIM 1 findings; 3) Evaluate the UTI Decide prototype with NH staff.

**Methods:** Focus groups were conducted with providers and nurses in NHs in Denver, Colorado (n=24). Qualitative descriptive analysis was applied to focus group transcripts to identify information needs and themes related to mobile clinical decision support for UTI identification and management. Personas representing typical end users were developed; typical clinical context scenarios were constructed using information needs as goals. Usability testing was performed using cognitive walk-throughs and a think-aloud protocol.

**Results:** Four information needs were identified including guidance regarding resident assessment; communication with providers; care planning; and urine culture interpretation. Design of a web-based application incorporating a published decision support algorithm for evidence-based UTI diagnoses proceeded with a focus on nursing information needs during resident assessment and communication with providers. Certified nursing assistant (CNA) and registered nurse (RN) personas were constructed in 4 context scenarios with associated key path scenarios. After field testing, a high fidelity prototype of UTI Decide was completed and evaluated by potential end users. Design recommendations and content recommendations were elicited.

**Conclusions:** Goal-Directed Design informed the development of a mobile CDSS supporting participant-identified information needs for UTI assessment and communication in NHs. Future work will include iterative deployment and evaluation of UTI Decide in NHs to decrease inappropriate use of antibiotics for suspected UTI.



Primary Presenter: **Ashton Kalhorn**

Project Title: *Maternal Serum Eye Drops in the Management of Pediatric Persistent Corneal Epithelial Defects: A Case Series*

Primary Mentor: Emily McCourt

Thematic Area: Clinical Science

Abstract:

Abstract

**Purpose:** We report our experience with the use of maternally derived serum eye drops as an adjunctive treatment in the management of pediatric persistent corneal epithelial defects.

**Patients and Methods:** 5 eyes in 4 patients were identified in a retrospective review of pediatric patients with persistent corneal epithelial defects who received maternal serum drops. Diagnoses associated with the defects were comprised of pontine tegmental cap dysplasia (PTCD) with bilateral cranial nerve V1, V2, V3, and VII palsies; PTCD with left cranial nerve V1, VII, and VIII palsies; traumatic left cranial nerve II, V1, V2, and VI palsies due to a basilar skull fracture, and Stevens-Johnson Syndrome (SJS) with ocular involvement. We evaluated the feasibility of using maternally derived serum drops; thus, we looked at the ability to prepare and tolerate the drops as well as any complications that could have been associated with the treatment. Other data collected included visual acuity, corneal examination, as well as current and previous treatments.

**Results:** The duration of therapy and time of follow-up both ranged from 5 to 28 months. All patients experienced improvement or resolution of their corneal epithelial defects within 3 weeks of initiating serum eye drops. Furthermore, there were no adverse effects from the use of allogeneic serum drops.

**Conclusion:** Maternal serum eye drops are a well-tolerated and potentially beneficial addition to the management of pediatric persistent corneal epithelial defects.

Primary Presenter: **Diane Kelly**

Project Title: *Reflexive blinking is abnormal in blepharospasm*

Primary Mentor: Brian Berman

Thematic Area: Clinical Science

Abstract:

Background: Blepharospasm (BSP) is a focal dystonia characterized by involuntary eye blinking resulting in mild to severe functional impairments.

Methods: The purpose of the present study was to investigate the neural correlates of reflexive blinking in BSP vs healthy controls (HC) using fMRI. 15 BSP (11F) patients and 15 HCs (11F) underwent an 8 minute fMRI scan during which air puffs were administered into each participants left eye in a pseudo-randomized fashion (40 per scan). Blink elicitation was confirmed using camera visualization. Data were analyzed in an event-related design and groups were compared using a two-sample t test with significance defined as  $p < 0.001$ .

Results: BSP patients showed decreased activity in the activation of their contralateral SII and areas involved in the integration of bl sensorimotor information.

Conclusions: Decreased contracortical projections may be involved in the central dysregulation and aberrant neuroplasticity of BSP.

Primary Presenter: **Paul Kim**

Project Title: *Emergency Care Assessment Tool for Health Facilities: A Validity Study in Cameroon*

Primary Mentor: Emilie Calvello-Hynes

Thematic Area: Global Health

Abstract:

## ABSTRACT

### Background

To date, health facilities in Sub-Saharan Africa have not had an objective measurement tool for evaluating comprehensive emergency service provision. One major obstacle is the lack of consensus on a standardised evaluation framework, applicable across a variety of resource settings. The Emergency Care Assessment Tool (ECAT) assesses provision of key medical interventions in Emergency Units via signal functions, which represent the culmination of knowledge of interventions, supplies, and infrastructure capable for the management of an emergent condition. We undertook a validation study to help determine the applicability of the tool in assessment of emergency services throughout the continent.

### Methods

This was an observational study at a convenience sample of five hospitals in Cameroon: three district, one regional, and one central. The goal of this study was to validate the instrument, not the facility, and so the sample size was related to the number of signal functions witnessed rather than the number of facilities visited. The tool was administered with the Head of Emergency at each facility. This completed ECAT was then compared with direct observations of the signal functions, a process which was conducted by the partner local emergency care specialists accompanied by the ECAT researcher.

### Results

In general, the higher the level of facility, the greater the emergency care capacity and the greater the number of signal functions that could be performed correctly and consistently. Discrepancies in funding, supplies, resource allocation, and care delivery ability were apparent through ECAT results, expounding on barriers to care delivery, and direct observation. McNemar tests on the ECAT results versus direct observation at each facility yielded statistically significant support for tool validation at the national level emergency centre as well as two of the district level emergency centres. Concordance between reported and observed signal functions could not be achieved at the regional centre and one of the district centres.

### Conclusions

The ECAT has good potential for facility level assessment of emergency care provision, and collects meaningful information that can guide effective improvements in the delivery of emergency care.

Primary Presenter: **Brandon Koenigsknecht**

Project Title: *Identifying Frequent Emergency Department Users Through a Statewide Health Information Exchange*

Primary Mentor: Roberta Capp

Thematic Area: Public Health and Epidemiology

Abstract:

Introduction

Care coordination services (CCS) provided to frequent emergency department (ED) users at the time of visit have shown to decrease ED recidivism. Actively identifying and characterizing this population during their ED visit remains challenging as some frequent users utilize multiple hospitals and single hospital electronic health records (EHR) do not capture this data.

Methods

Quality improvement study conducted at a large urban academic ED with approximately 100,000 ED annual visits from June 2015 - August 2015 used Student Patient Navigators (SPNs) 7 days a week, 24 hours a day, to provide CCS for patients. SPNs utilized the EDs EHR and the state wide Health Information Exchange (HIE) website in real-time to identify frequent ED users defined as  $\geq 3$  ED visits over 6 months. We used a multivariable logistic regression to assess the association of patient characteristics and multiple hospital utilization.

Results

Of the 2,346 patients approached, 1,856 (79%) agreed to conduct a socio-health screening. Mean age was 40 ( $\pm 15.12$ ) years old and 1,140 (61%) were females. We identified 339 (18%) frequent ED users through the single hospital EHR and 495 (26%) frequent ED users through the state wide HIE, ( $p < .0001$ ). Among frequent ED users, patients were less likely to use multiple hospitals if they were Black [ref=White (OR 0.46; 95% CI, 0.27-0.79)], had no insurance or Medicaid [ref= private (OR= 0.22; 95% CI, .06-.72); (OR=0.37; 95% CI: 0.27-0.79)] or had a primary care provider (OR= 0.51; 95% CI: 0.33-0.80).

Conclusion

State wide HIE use resulted in a greater number of individuals being identified as frequent ED users by utilizing information collated from multiple EDs allowing more patients to benefit from CCS.

Primary Presenter: **Jason Koerner**

Project Title: *EFFECT OF SPLIT POSTERIOR TIBIALIS TENDON TRANSFER ON FOOT PROGRESSION ANGLES IN CHILDREN WITH CEREBRAL PALSY*

Primary Mentor: Jason Rhodes

Thematic Area: Clinical Science

Abstract:

Background:

The split posterior tibialis tendon transfer (SPOTT) has had mixed results on the efficacy in treating hindfoot varus and inversion deformities in children with cerebral palsy (CP). The deformity is due to over-activation of the posterior tibialis muscle. In the past, goniometer angular measurements were used to quantify surgical correction but had a high risk of human error. Now with computerized gait analysis, precise measurements of kinematics and kinetics can be obtained. We used gait analysis to determine the change in FPA following SPOTT that can be considered when correcting rotational deformities and lever arm disease.

Methods:

We completed a retrospective analysis on 24 feet from 20 participants with a mean age of 7 (range 4-15). All participants had a diagnosis of CP and underwent SPOTT between 2006 and 2015. FPAs were measured via gait analysis at both pre- and post-operative visits. Participants with rotational procedures other than SPOTT between gait analyses that would affect FPA were excluded. FPAs were then compared to the normative calculated average FPA of 8 degrees external rotation (-8) based on age-specific FPA data obtained at this institution. The absolute difference from pre- to post-op FPA was assessed via paired t-test.

Results:

The mean of the preoperative FPA, 9.4 (95% CI: 3, 15.7), was significantly different from -8,  $p < 0.0001$ . The mean of the postoperative FPA, 0.8 (95% CI: -4.7, 6.3), was also significantly different from -8,  $p = 0.003$ . The mean of the differences from post to preoperative FPA from normal, -6.5 (95% CI: -12.5, -0.4), was significantly different from 0;  $p = 0.0383$ . The average change in FPA was 8.6 degrees external rotation (-8.6) (95% CI: -16.5, -0.7) and was significantly different from 0;  $p = 0.035$ .

Conclusions:

SPOTT can provide 8.6 degrees of external rotation improvement in FPA for children with hindfoot varus and inversion deformities that have a diagnosis of CP with active posterior tibialis in swing. The use of computerized gait technology could allow for more precise, repeatable, and quantifiable data as a means to measure surgical outcomes.

Level of Evidence:

Level of evidence IV

Primary Presenter: **Nazanin Kuseh Kalani Yazd**

Project Title: *Assessing Attitudes of Colorado Physicians and Pharmacists on Over the Counter Provision of Progesterone-Only Contraceptive Pills*

Primary Mentor: Carol Stamm

Thematic Area: Public Health and Epidemiology

Abstract:

**Background:** Recently, legislation has been proposed nationally to provide easier access to oral contraceptive pills. The proposed legislation entitled Allowing Greater Access to Safe and Effective Contraception Act seeks to allow “routine-use contraceptives” to be sold over-the-counter (OTC). This legislation would increase women's access to contraception; however, it could also increase out-of-pocket cost because the Affordable Care Act contraception provision only covers prescription contraception. Alternative legislation entitled Affordability Is Access Act requires health insurance to cover costs of oral contraception when it becomes OTC. California and Oregon have transitioned to allow access to oral contraception through pharmacist provision. Undeniably, political and healthcare leaders are investigating alternative methods of access to oral contraception. The goal of this study was to assess and compare the perceptions of Colorado physicians, pharmacists, and pharmacy technicians on OTC access to progestin-only oral contraception in order to identify specific concerns among health professionals to inform future policy and to guide effective provider education.

**Methods:** A physician-specific survey was created for faculty physicians in internal medicine, family medicine, and obstetrics and gynecology at the University of Colorado School of Medicine and emailed to faculty members. A pharmacist and pharmacy technician specific survey was created for pharmacists and pharmacy technicians practicing in Denver County outpatient pharmacies. Two student researchers visited 74 randomly selected pharmacies on the list of Denver pharmacies, and they attempted to obtain responses from one pharmacist and one pharmacy technician at each site. Survey responses were compared among respondent groups using chi-square and Fishers exact tests.

**Results:** Responses were collected from 56 physicians, 58 pharmacists, and 43 pharmacy technicians. There was a statistically significant relationship between profession (physician, pharmacist, and pharmacy technician) and how confident the survey participant felt about patients correctly using the progestin-only contraception without prior consultation ( $p$ -value=0.0318). Surveyed physicians, pharmacists, and pharmacy technicians “somewhat agree” that OTC progestin-only contraception will have a positive impact on women's health (58.93%, 56.14%, and 41.64% respectively), and there was no statistically significant difference among groups ( $p$ -value=0.142). However, there was a significant difference on top concern of OTC access of progestin-only contraception ( $p$ -value <0.001). The biggest concern of physicians was efficacy of progestin-only contraception (35.71%), while pharmacists and pharmacy technicians both responded that patient self-assessment of contraindications was their top concern, (35.09% and 23.82% respectively).

**Conclusions:** Our study has shown that there are differing views among healthcare professionals on OTC provision of progestin-only contraception. This study builds upon previous literature including the work of Daniel Grossman et. al that indicates that most women are able to self-assess for contraindications

using simple checklists. Given recently proposed legislation, it is crucial to seek the perspectives of primary stakeholders, including physicians and pharmacists. Legislators should address the concerns of healthcare professionals before moving forward with OTC provision. While provider/physician prescribing is a barrier to contraceptive access and adherence, moving oral contraception to OTC status may create unforeseen barriers including removing insurance copays and increasing direct costs to women. Affordable prices, assured insurance reimbursement, and clear packaging may alleviate some concerns.

Primary Presenter: **Thien Le**

Project Title: *Efficacy and Impact of an LGBT Health and Healthcare Elective for First and Second Year Medical Students*

Primary Mentor: Rita Lee

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Background: Individuals who identify as lesbian, gay, bisexual, or transgender (LGBT) face significant health disparities. Despite growing awareness, most medical students receive minimal exposure to the special health needs of and barriers to care encountered by LGBT individuals. We implemented a 10-hour LGBT health elective for first- and second-year medical students at the University of Colorado to fill this gap in medical education. Methods: The elective consists of five 2-hour sessions, including: LGBT-related terminology and communication skills; health care needs specific to LGBT youth and adults; a panel discussion with LGBT community members; and communication skills practice with standardized patients. Course participants completed global pre- and post-course surveys to assess prior experience in working with this population regarding, self-confidence in caring for this population, and knowledge of LGBT health issues. Results: Three cohorts of students (n=47) have completed the course to date. Students showed a statistically significant increase in all facets, including comfort eliciting a sexual history (60% to 95%;  $p < 0.001$ ), sex anatomy and gender identity (38% to 98%;  $p < 0.001$ ) as well as ability to articulate the special health needs (LGB: 25% to 100%,  $p < 0.001$ ; T: 17% to 100%,  $p < 0.001$ ), primary care recommendations (LGB: 15% to 100%,  $p < 0.001$ ; T: 2% to 100%;  $p < 0.001$ ), and community resources for LGBT patients (29% to 98%;  $p < 0.001$ ). Knowledge acquisition showed a modest increase (50% to 58% correct;  $p = 0.09$ ). Discussion: Improving self-confidence, knowledge, and communication skills in caring for LGBT patients requires a multi-modal, iterative educational approach. Our learners demonstrated significant improvement in self-confidence in interacting with LGBT patients. However, actual knowledge only increased modestly. For future cohorts, we need to rebalance the amount of clinically focused content in a course geared toward pre-clinical learners. Impact: We are training a cohort of students who are more confident in their ability to care for LGBT patients in a culturally-responsive manner, which is a first step in addressing health disparities. Furthermore, our data have been used to influence the Phase II Sexual History Taking Communication Session and will be used to inform the integration of LGBT-related content into the core curriculum.



Primary Presenter: **Amy Leach**

Project Title: *Long Acting Reversible Contraception in Colorado: Demand, Barriers to Use, and Solutions*

Primary Mentor: Mark Deutchman

Thematic Area: Public Health and Epidemiology

Abstract:

Access to long acting reversible contraception (LARC) can dramatically reduce unintended pregnancy. This study is a survey of the current use of LARC in Colorado clinics and of provider interest in additional resources to increase utilization of LARC. A standardized survey was sent to 182 rural and safety net clinics. The survey asked about the use of IUDs and implants, barriers to use, and the providers desire for additional training. The survey demonstrated that LARC services are being provided at many of the rural and safety-net clinics across Colorado. The primary barriers that prevent these services from reaching populations in need include lack of provider training and the perceived expense of LARC methods. There is a desire for written materials to support providers offering these services, and an online module may be an effective way to disseminate this information. Updated information regarding insurance coverage of LARC and low-cost options for uninsured patients may help dispel misunderstandings that persist about the cost associated with LARC methods.

Primary Presenter: **Justin Lee**

Project Title: *Analyzing adverse outcomes of subanesthetic ketamine infusions in pediatric patients in non-intensive care units*

Primary Mentor: Patrick Fernandez

Thematic Area: Clinical Science

Abstract:

Subanesthetic ketamine infusions are often employed adjuvantly in managing perioperative pain or as the primary source in non-opioid based analgesia. Unfortunately, higher ketamine doses may cause adverse side effects including but not limited to: central nervous system excitation, sedation, hemodynamic changes, and respiratory depression. In contrast, subhypnotic or subanesthetic infusions (<300mcg/kg/hr) have a far more favorable safety margin. However, concerns remain and, thus, many hospitals institute policies restricting low-dose infusions to higher level of care units (i.e. ICU, PACU). Not only can this be cost-prohibitive, but it also limits access to an otherwise useful treatment. Our institution has been administering low dose ketamine infusions in unmonitored pediatric units for several years. To date there have been few studies that have analyzed the safety margin of low dose ketamine infusions especially in the pediatric population. There is a need to better analyze subanesthetic ketamine related safety margin in the pediatric population. We conducted a retrospective analysis of patients aged 0-21 who received low dose ketamine infusions in general pediatric wards at our institution over 2012-2017. We hypothesized that subanesthetic low dose ketamine infusions can be used in general pediatric wards safely. Our results confirmed our hypothesis with no serious adverse incidents being captured and a minimal side effect profile being created.

Primary Presenter: **Terry Lefcourt**

Project Title: *A Molecular Mechanism of the Inflammatory Response in Different Aged Fibroblasts*

Primary Mentor: Ohe Liecthy

Thematic Area: Basic Biomedical Science

Abstract:

Compared to the adult response to injury, the inflammatory response and scar formation in neonates is decreased. We have previously shown that increased fibroblast age is associated with increased production of pro-inflammatory cytokines. Recent evidence suggests that one of the most important regulatory factors of protein production are microRNAs. One such microRNA, microRNA-146a (miR-146a), regulates the inflammatory response by suppressing interleukin 6 and 8 (IL-6, IL-8). Epigenetic regulation such as histone modification has been implicated as a modulatory factor in microRNA expression. We hypothesize that differentially expressed inflammatory cytokines related to miR-146a regulation in different age groups is under epigenetic control, and that the increased production of pro-inflammatory cytokines by fibroblasts with increasing age may be due to decreased expression of miR-146a. To test this hypothesis, we examined the expression of miR-146a, and its target proteins at baseline, as well as after treatment with two known histone deacetylase inhibitors (HDACi). We attempted to describe changes in promoter region methylation patterns using bisulfite conversion and sequencing. MiR-146a expression at baseline significantly decreases with age, and both Nfkb and IL-6 increase with age. Treatment with HDACi decreased MiR-146a expression, and suppressed expression of both Nfkb and IL-6 through downregulation of interleukin receptor associated kinase 1 (IRAK 1); however, expression of IL-8 was increased. Results of bisulfite sequencing were inconclusive. These results oppose the hypothesis that the miR-146a regulated inflammatory response is sensitive to epigenetic modulation via histone deacetylation. However, our results add to the evidence that HDACi can block Nfkb activity, and have considerable therapeutic potential in conditions of dysregulated inflammation.

Primary Presenter: **Katherine Lind**

Project Title: *Idiopathic Pulmonary Fibrosis Associated with MUC5B Promoter Variant Upregulates Androgen Receptor Network Signaling*

Primary Mentor: David Schwartz

Thematic Area: Clinical Science

Abstract:

Idiopathic pulmonary fibrosis (IPF) is a complex disorder associated with significant morbidity and mortality. We recently reported a promoter variant of the MUC5B gene (rs35705950) that accounts for at least 30% of the risk of developing disease<sup>1</sup>, as well as 10 IPF risk loci, encompassing 66 genes with broad functions including host defense, cell-cell adhesion and DNA repair. Ingenuity Pathway Analysis (IPA) of genes within GWAS loci identified a network centered around the Androgen Receptor (AR). Given male predominance of IPF and the association of AR in the development of fibroblastic foci<sup>2</sup>, a typical histological feature of IPF, we focused on the AR and three additional genes in that network- DISP2, OBFC1 and AZGP1. We hypothesized that dysregulation of this genetic network may be associated with IPF, possibly with associations with sex or the MUC5B promoter variant. Expression was evaluated by both immunohistochemistry and quantitative real-time polymerase chain reaction (RT-PCR). In controls, nuclear AR was expressed by epithelial cells of large and small airways, with intensity and distribution of expression significantly greater in males and those subjects with the MUC5B variant. In IPF, AR expression was significantly upregulated in lung tissue of males with MUC5B variant. AZGP1 was cytoplasmic in central and peripheral airway epithelial cells of controls, decreased in IPF lung without the MUC5B variant, but restored in IPF with the MUC5B variant. DISP2 and OBFC1 were observed in normal control lung and IPF lung of all genotypes, although some variability in the staining patterns were observed. By RT-PCR, each of the four genes was down-regulated in IPF lung tissue as compared to controls in MUC5 WT patients. In MUC5B variant patients, however, AR and AZGP1 were significantly upregulated. These data suggest androgen receptor signaling (AR and AZGP1) upregulation in IPF in patients with the MUC5B promoter variant.

Primary Presenter: **Charlie Lockwood**

Project Title: *Highload preconditioning of human soft tissue hamstring grafts: An in vitro biomechanical analysis*

Primary Mentor: Allan Prochazka

Thematic Area: Basic Biomedical Science

Abstract:

**Purpose** In order to minimize viscoelastic elongation of ACL reconstruction grafts, preconditioning protocols have been employed in clinical practice prior to final graft fixation. The purpose of this study was to evaluate two separate high-load static preconditioning protocols of double-looped semitendinosus-gracilis grafts and compare these results to both a current clinical protocol and a control group with no preconditioning protocol applied. It was hypothesized that a high-load, static preconditioning protocol would minimize graft elongation during a simulated progressive early rehabilitation compared to both the 89 N clinical protocol and control groups.

**Methods** Grafts were randomly allocated into four preconditioning

study groups: (1) control (no preconditioning), (2) clinical protocol (89 N for 15 min), (3) high-load, short duration (600 N for 20 s), and (4) high-load, long duration (600 N for 15 min). After preconditioning, grafts were

cyclically loaded between 10 and 400 N at 0.5 Hz for 450 cycles to simulate early postoperative rehabilitation. Graft displacement (elongation) was recorded during both preconditioning and cyclic loading.

**Results** Increased preconditioning load magnitude and duration significantly reduced graft elongation during cyclic loading ( $p < 0.05$ ) which corresponded to an inverse relationship with increased elongation during preconditioning. The 600 N for 15 min protocol resulted in significantly less elongation during simulated early rehabilitation than both the control group and the 89 N for 15 min protocol ( $p < 0.001$ ,  $p < 0.05$ ).

**Conclusions** Graft elongation during simulated early rehabilitation

was significantly reduced by a high-load preconditioning protocol applied for an extended period of time compared to a current common clinical protocol and grafts that were not preconditioned. In addition, the amount of elongation during simulated early rehabilitation was similar between grafts preconditioned using the current clinical practice protocol and the high-load/short-duration protocol, implying that the latter could potentially induce the same viscoelastic changes in soft tissue grafts as the current clinical practice. The 600 N for 20 s preconditioning protocol may

provide similar postoperative results as the clinical protocol, 89 N for 15 min, and also reduce or maintain operative time. A high-load preconditioning protocol that reduces graft elongation may benefit patients undergoing ACL reconstruction, especially for cases of failed primary reconstruction, genu

recurvatum, and increased tibial slope, where maintaining graft length is imperative to restore knee stability.

Primary Presenter: **Lauren MacDonald**

Project Title: *Hemodynamic Changes During Induction of Anesthesia:*

*A New Noninvasive Computational Method vs.*

*Traditional Vital Signs*

Primary Mentor: Richard Ing

Thematic Area: Clinical Science

Abstract:

Abstract:

**Introduction:** The induction of anesthesia is often associated with hypotension due to a drop in systemic vascular resistance and re-distribution of central circulating volume to the peripheral vasculature. Traditional vital signs (heart rate [HR], blood pressure [BP]) are late indicators of this change, and often unreliable. Studies have demonstrated that photoplethysmogram (PPG) waveforms obtained with a pulse oximeter change significantly with volume loss. Computational methods (feature extraction and machine learning) were used to analyze PPG waveforms to create an algorithm called the Compensatory Reserve Index (CRI). CRI is a unique non-invasive continuous measurement that corresponds to varying degrees of central volume loss. A CRI of 1 indicates supine normovolemia, while a CRI of 0 indicates the point at which the patient is at highest risk of hemodynamic decompensation. Values between 1 and 0 indicate the compensatory reserve of the subject. The CRI does not require a reference measurement to normovolemia and is displayed on a scale of 1 to 0, which represents the same information for individual subjects.

**Hypothesis:** We hypothesized that CRI values will decrease due to redistribution of blood volume during induction of anesthesia prior to changes in HR and BP.

**Methods:** A prospective, IRB approved, study was conducted. Inclusion criteria were healthy children undergoing elective dental restoration, cardiac catheterization, and cardiac electrophysiological studies under general anesthesia. Exclusion criteria were patients under 30 days old or greater than 18 years or age. Informed consent was obtained. CipherOx CRI (Flashback Technologies Inc., Louisville, CO) data was recorded from the pre-operative period until procedure completion. These data were later analyzed by the CRI algorithm to produce CRI values. This device did not display any data during the study period. Demographics, vital signs, and other clinical data were collected from the electronic anesthesia record. These were summarized with medians and percentiles or means and standard deviations for continuous variables, and proportions for categorical variables. These were then stratified by procedure type. Thresholds for a significant change in CRI (16%) or vital signs were based on previous evidence and published clinical practices (Stewart 2014). A one sample T-test was used to assess whether the time to decrease in CRI and MAP was significantly different than zero. R version 3.3.1 (R Foundation for Statistical Computing, Vienna, Austria) was utilized.

**Results:** A total of 115 patients were enrolled, 72 patients had data analyzed and 43 were excluded: 20 subjects excluded were due to technical issues, and 23 excluded because data was collected after

induction. The mean time to 16% decrease in CRI following induction was  $4.3 \hat{\pm} 4.3$  minutes (n=63), whereas the mean time to 25% increase in HR and 20% decrease in MAP were  $4.2 \hat{\pm} 4.6$  minutes (n=48) and  $9.2 \hat{\pm} 5.8$  minutes (n=52), respectively. On average, for the 44 patients who had both a 16% drop in CRI and a 20% drop in MAP, the drop in CRI occurred 4.1 minutes prior to a drop in MAP. This difference is statistically significantly different from zero (95% CI: 2.09, 6.18; p=0.0002). The difference is also significant within each procedure type group (cardiac: p=0.002, dental: p=0.04). This may reflect differences in capacity for hemodynamic compensation and different anesthetic induction techniques in the two groups.

Conclusions: During induction of general anesthesia, CRI decreased earlier than MAP. CRI provides real-time, noninvasive, moment-to-moment insight into hemodynamic changes associated with compensation during induction of general anesthesia earlier than traditional vital signs.



Primary Presenter: **David Mack**

Project Title: *Developing Mobile Clinical Decision Support for Nursing*

*Home Staff Assessment of Urinary Tract Infection using*

*Goal-Directed Design*

Primary Mentor: Heidi Wald

Thematic Area: Clinical Science

Abstract:

**Background:** Unique characteristics of nursing homes (NHs) contribute to high rates of inappropriate antibiotic use for asymptomatic bacteriuria (ASB), a benign condition. A mobile clinical decision support system (CDSS) may support NH staff in differentiating urinary tract infections (UTI) from ASB and reducing antibiotic days.

**Objectives:** We used Goal-Directed Design to: 1) Characterize information needs for UTI identification and management in NHs; 2) Develop UTI Decide, a mobile CDSS prototype informed by personas and scenarios of use constructed from Aim 1 findings; 3) Evaluate the UTI Decide prototype with NH staff.

**Methods:** Focus groups were conducted with providers and nurses in NHs in Denver, Colorado (n= 24). Qualitative descriptive analysis was applied to focus group transcripts to identify information needs and themes related to mobile clinical decision support for UTI identification and management. Personas representing typical end users were developed; typical clinical context scenarios were constructed using information needs as goals. Usability testing was performed using cognitive walk-throughs and a think-aloud protocol.

**Results:** Four information needs were identified including guidance regarding resident assessment; communication with providers; care planning; and urine culture interpretation. Design of a webbased application incorporating a published decision support algorithm for evidence-based UTI diagnoses proceeded with a focus on nursing information needs during resident assessment and communication with providers. Certified nursing assistant (CNA) and registered nurse (RN) personas were constructed in 4 context scenarios with associated key path scenarios. After field testing, a high fidelity prototype of UTI Decide was completed and evaluated by potential end users. Design recommendations and content recommendations were elicited.

**Conclusions:** Goal-Directed Design informed the development of a mobile CDSS supporting participant-identified information needs for UTI assessment and communication in NHs. Future work will include iterative deployment and evaluation of UTI Decide in NHs to decrease inappropriate use of antibiotics for suspected UTI.

Primary Presenter: **William Madry**

Project Title: *Retrospective study of phalangeal neck fractures in children*

Primary Mentor: Frank Scott

Thematic Area: Clinical Science

Abstract:

A retrospective study of proximal and middle phalangeal fractures in the pediatric population demonstrates the need for definitive surgical management via closed reduction with percutaneous pinning or open reduction with internal fixation to improve long-term outcomes in cases with significant displacement in the sagittal plane.

Primary Presenter: **Helen Madsen**

Project Title: *Food Access in Elyria Swansea- A review*

Primary Mentor: Rita Lee

Thematic Area: Public Health and Epidemiology

Abstract:

Food deserts are areas in which access to grocery stores and diverse food options are extremely limited. These may exist even within urban areas, especially in neighborhoods without good access to public transportation. Elyria Swansea is one such neighborhood, located in Denver, Colorado. Growhaus is an organization working in Elyria Swansea to bridge the gap in access to healthy food, by growing healthy food on site, and by selling it at subsidized prices to neighborhood inhabitants. Furthermore, Growhaus is attempting to work towards food education, including cooking and agricultural classes. We worked with Growhaus in order to evaluate the health of the Elyria Swansea neighborhood, focusing on access to food in the area, and the problems facing the inhabitants. The paucity of food options negatively impacts inhabitants, and the issue is further complicated by specific cultural and economic needs of the residents. Food deserts are a detriment to health, and cause neighborhood wide effects.

Primary Presenter: **Audrey Magnowski**

Project Title: *Complications associated with ventriculoperitoneal shunt and gastrostomy tube placement on same admission*

Primary Mentor: Thor Johnson

Thematic Area: Clinical Science

Abstract:

**Objective:** Complication rate associated with concomitant placement of a ventriculoperitoneal shunt (VPS) and a gastrostomy tube (GT) is controversial. We aim to determine complication rates following VPS insertion alone versus with concomitant GT placement.

**Methods:** Patients 18 years and older were included in the analysis if a VPS was placed between January 2006 and April 2016 at a single institution. 218 patients met inclusion criteria, 38 of which had a GT placed during the same admission. Complications in the 6 weeks following VPS placement including infection, obstruction, re-operation, readmission, and mortality were compared between groups.

**Results:** Mean interval between VPS and GT was  $20.7 \pm 24$  days. 16 of 38 patients receiving both procedures and 87 of 180 patients receiving VPS only were male ( $p=0.592$ ). Patient age did not differ by GT placement (VPS and GT: mean  $53.3 \pm 14.8$  years, VPS: mean age  $48.5 \pm 19.4$  years;  $p=0.092$ ). 27.1% (95% CI: 21.2%–33.0%) of patients experienced a complication; the proportion of patients having any complication did not differ by GT placement ( $p=0.316$ ). Patients receiving a GT were less likely to be readmitted in the follow-up interval (VPS and GT: 5%, VPS: 19%;  $p=0.052$ ). There were no differences in patient characteristics by complication status ( $p>0.05$  for each).

**Conclusions:** Concomitant VPS and GT placement did not significantly impact infection, obstruction, re-operation, mortality, or overall complication rate compared to VPS placement alone. During the six-week post-procedural interval, a higher proportion of patients with VPS alone were readmitted, demonstrating a potential advantage to GT feeding following VPS placement.

Primary Presenter: **Erica Martinez**

Project Title: *Efficacy and Impact of an LGBT Health Elective for First- and Second-Year Medical Students*

Primary Mentor: Rita Lee

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Background: Individuals who identify as lesbian, gay, bisexual, or transgender (LGBT) face significant health disparities. Despite growing awareness, most medical students receive minimal exposure to the special health needs of and barriers to care encountered by LGBT individuals. We implemented a 10-hour LGBT health elective for first- and second-year medical students at the University of Colorado to fill this gap in medical education. Methods: The elective consists of five 2-hour sessions, including: LGBT-related terminology and communication skills; health care needs specific to LGBT youth and adults; a panel discussion with LGBT community members; and communication skills practice with standardized patients. Course participants completed global pre- and post-course surveys to assess prior experience in working with this population regarding, self-confidence in caring for this population, and knowledge of LGBT health issues. Results: Three cohorts of students (n=47) have completed the course to date. Students showed a statistically significant increase in all facets, including comfort eliciting a sexual history (60% to 95%;  $p < 0.001$ ), sex anatomy and gender identity (38% to 98%;  $p < 0.001$ ) as well as ability to articulate the special health needs (LGB: 25% to 100%,  $p < 0.001$ ; T: 17% to 100%,  $p < 0.001$ ), primary care recommendations (LGB: 15% to 100%,  $p < 0.001$ ; T: 2% to 100%;  $p < 0.001$ ), and community resources for LGBT patients (29% to 98%;  $p < 0.001$ ). Knowledge acquisition showed a modest increase (50% to 58% correct;  $p = 0.09$ ). Discussion: Improving self-confidence, knowledge, and communication skills in caring for LGBT patients requires a multi-modal, iterative educational approach. Our learners demonstrated significant improvement in self-confidence in interacting with LGBT patients. However, actual knowledge only increased modestly. For future cohorts, we need to rebalance the amount of clinically focused content in a course geared toward pre-clinical learners. Impact: We are training a cohort of students who are more confident in their ability to care for LGBT patients in a culturally-responsive manner, which is a first step in addressing health disparities. Furthermore, our data have been used to influence the Phase II Sexual History Taking Communication Session and will be used to inform the integration of LGBT-related content into the core curriculum.

Primary Presenter: **Brett Matoian**

Project Title: *Preventing Proximal Adjacent Level Kyphosis With Strap Stabilization*

Primary Mentor: Vikas Patel

Thematic Area: Clinical Science

Abstract:

Abstract

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A substantial proportion of patients develop proximal junctional kyphosis following spinal surgery. To combat this postoperative change, several techniques have focused on maintaining the structural integrity of adjacent spinal levels and adapting the proximal end of the fusion construct to accommodate the increased mechanical stressors produced by long spinal fusion. The use of Mersilene tape (Ethicon, Somerville, New Jersey) for spine and orthopedic surgery is well documented, although considerably less is known about its use for preventing proximal junctional kyphosis. This article describes a proposed technique using Mersilene tape to provide a check-rein strap stabilization at the proximal end of fusion constructs. Initial data suggest that use of this technique may prevent formation of proximal junctional kyphosis. [Orthopedics. 2016; 39(4):e794-e799].

Primary Presenter: **Ruthanne McCoy**

Project Title: *Sick Student Doctor*

Primary Mentor: Steven Lowenstein

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

There is no abstract as this is a narrative.

Primary Presenter: **Morgan Meury**

Project Title: *A Pre-Health Mentorship Program to Alleviate Physician Shortages in Colorado Springs*

Primary Mentor: John Frerichs

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Abstract

The University of Colorado School of Medicine opened a new branch campus in 2016 in the underserved city of Colorado Springs, in partnership with the undergraduate campus University of Colorado-Colorado Springs (UCCS). With the formation of this partnership, medical students from the University of Colorado School of Medicine developed an multi-modal advising and mentorship program for the UCCS prehealth undergraduate students. Undergraduate students identified their areas of advising need, which predominantly included finding relevant work experiences, shadowing opportunities, MCAT preparations, and general advice regarding the general process of applying to medical school. Medical students were able to provide one on one counseling on over eighty percent of the areas of need identified over the first phase of the program. Additionally, through the partnership medical students were able to address all areas of need through panel discussions. Further, areas of need were directly addressed through cooperation for community outreach between medical students and undergraduate students. Long term aims of the project are to retain pre-health students in the Colorado Springs community, as well as to improve diversity in the University of Colorado School of Medicine student body. Long term follow up will be needed to measure these future goals.



Primary Presenter: **Timothy Miller**

Project Title: *Estimation of the Prevalence and Distribution of Computer-Assisted Quantitative Immunohistochemistry in the United States Using Publicly-Available Medicare Data*

Primary Mentor: Toby Cornish

Thematic Area: Clinical Science

Abstract:

### Background

Quantitative immunohistochemistry (QIHC) has become a vital histopathological tool for prediction and prognosis. Estrogen receptor, progesterone receptor, Her2, and Ki67 are exemplars of QIHC. QIHC can be performed manually (QIHC-M) or with the assistance of computerized image analysis (QIHC-IA). As digital pathology and computational pathology come to the fore in routine pathology practice, many questions about the current utilization of QIHC-IA are unaddressed. For example, what portion of QIHC employs image analysis and which labs are using QIHC-IA? This study represents the first detailed analysis of the prevalence of QIHC-IA.

### Methods

All Medicare Provider Utilization and Payment Data: Physician and Other Supplier files (PUFs) and the Part B National Summary Data Files were downloaded from the Centers for Medicare and Medicaid services (CMS) website. These publicly available files aggregate all Medicare payments by National Provider Identifier (NPI) or Healthcare Common Procedure Coding System (HCPCS) code. The HCPCS maps to American Medical Association (AMA) Current Procedural Terminology (CPT®) billing codes, allowing IHC, QIHC-M and QIHC-IA volumes and billing NPIs to be extracted for recent years. Medicare data files were imported into pandas for data analysis.

### Results

From 2012 to 2015 12,912 providers billed a total of 21,101,197 IHC units. 12,795 providers billed for qualitative IHC; 4,500 providers billed for QIHC-M, and 1,590 providers billed for QIHC-IA. During this time period, qualitative IHC represented 84.3% of all IHC units billed. 67.9% of QIHC units were QIHC-M and 32.1% were QIHC-IA. While individual providers performed 73.8% of all IHC and organization providers performed the remaining 26.2%, the proportion of QIHC-IA is highly enriched in organization providers, which cumulatively performed 29.6% of their QIHC using image analysis compared to 5.4% for individual providers.

### Conclusions

We have used publicly available Medicare payment data to estimate the prevalence and distribution of QIHC practices. Overall, QIHC-IA represents almost one-third of all QIHC performed, but its practice is highly enriched in large organizational providers such as centralized reference labs that specialize in immunohistochemistry. Although there are limitations to using Medicare billing data for this purpose, we feel this study fairly represents the overall picture of QIHC in the United States.

Primary Presenter: **Christopher Moreau**

Project Title: *Use of Video Media for the Instruction of Physical Exam in the Preclinical Years*

Primary Mentor: Todd Guth

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Physical examination remains a core clinical skill of any practicing physician, both for the purposes of connecting with patients, and as one of the most reliable and readily-available diagnostic tools clinicians have. Medical education at all levels, from national accrediting and licensing bodies to individual medical schools continue to emphasize competencies in physical examination, with training based in face-to-face instruction, standardized patient sessions, and limited clinical experiences prior to the clinical training years. The dropping cost of video production, paired with widely-available and popular web-hosting platforms have made this a golden age for the use of video and other web-based media in medical education. Moreover, the use of these media may complement resource and time constraints medical schools face in teaching core clinical skills. We developed an instructional video series under the University of Colorado School of Medicines Foundations of Doctoring Curriculum to supplement the physical examination instruction, and to determine if application of this media was a feasible resource that students would take advantage of. In post-distribution surveys following the students first OSCE, we found that responding students received the videos exceptionally well as a supplement to the standard curricular resources provided to them.

Primary Presenter: **Margaret Moser**

Project Title: *Literature Review: Best Practices for Nutrition Education Programs for Unstably Housed Veterans Living in a VA Homeless Domiciliary*

Primary Mentor: Cathy Battaglia

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Nutrition education is changing. Beliefs around food and nutrition are complex and challenging to address. Many population are at risk of experiencing poor nutrition. This is especially true for veterans in unstable housing. This comprehensive literature review examines best practices for nutrition education in this population. The main focus of topics included homeless nutrition and associated risk factors, assessment of both nutritional status and knowledge, benefits of nutritional education programs and analysis of related cohort studies, and optimization of nutrition education programs and managing learning difficulties.

Recommendations are that nutrition education programs are effective to improve nutrition and behavior. Programs are more successful when tailored to the group and more so to the individual. Educational barriers should be addressed and multiple modes of media are encouraged. Nutritional screens should be used that best fit the population both as an assessment tool and to introduce the idea of nutrition to the patient. Finally, nutrition programs found great benefit when teaching facilities included kitchens. The greatest limitation was the lack of relevant for this population in such a complex field.

Primary Presenter: **Ethan Muhonen**

Project Title: *Self-assembling peptides for stem cell and tissue engineering*

Primary Mentor: Ethan Muhonen

Thematic Area: Basic Biomedical Science

Abstract:

Regenerative medicine holds great potential to address many shortcomings in current medical therapies. An emerging avenue of regenerative medicine is the use of self-assembling peptides (SAP) in conjunction with stem cells to improve the repair of damaged tissues. The specific peptide sequence, mechanical properties, and nanotopographical cues vary widely between different SAPs, many of which have been used for the regeneration of similar tissues. To evaluate the potential of SAPs to guide stem cell fate, we extensively reviewed the literature for reports of SAPs and stem cell differentiation. To portray the most accurate summary of these studies, we deliberately discuss both the successes and pitfalls, allowing us to make conclusions that span the breadth of this exciting field. We also expand on these conclusions by relating these findings to the fields of nanotopography, mechanotransduction, and the native composition of the extracellular matrix in specific tissues to identify potential directions for future research.

Primary Presenter: **Carrie Myers**

Project Title: *The South African emergency medicine elective: A unique approach to global health education among medical students*

Primary Mentor: Jennifer Bellows

Thematic Area: Global Health

Abstract:

As international electives become increasingly popular among students, medical schools have expanded their integration of global health elective curricula. Ideally, these programs foster clinical knowledge and personal growth in the student participant while providing a lasting benefit to the host site. However, many such programs suffer the common pitfalls of inadequate student preparation and insufficient oversight while abroad. Additionally, the community visited is at risk of being exploited with little meaningful benefit to their patients or medical system. The CUSOM (University of Colorado School of Medicine) South Africa Elective (SAE) is a distinctive program that aims to minimize these limitations while retaining benefit to the student. Extensive participant selection, formalized pre-departure preparation, and direct in-country clinical oversight ensure that students and hosts are optimally insulated from risks associated with short-term global health trips. A focus on collaborative research and longitudinal relationships with South African emergency physicians ensure a symbiotic partnership between hosts and participants. In surveying a decades worth of SAE alumni, we find the model of the South Africa Elective uniquely implements many of the standards of a successful global health elective while avoiding many of the common hazards.

Primary Presenter: **Barbara Neistadt**

Project Title: *Diagnostic considerations of natural killer/T-cell lymphoma with secondary hemophagocytic lymphohistiocytosis in pregnancy*

Primary Mentor: Michael Zaretsky

Thematic Area: Clinical Science

Abstract:

Background:

Hemophagocytic lymphohistiocytosis (HLH) is a rare and potentially fatal disorder. It is challenging to diagnose and treat in pregnancy due to its rarity and variation in clinical presentation, laboratory abnormalities, and underlying etiologies. We describe a previously healthy woman who presented in the late second trimester of pregnancy with HLH secondary to T-cell lymphoma.

Case:

A 27-year-old Hispanic woman, gravida 2 para 1001 at 27 and 5/7 weeks gestation presented with fever, hypotension, pancytopenia, hyperferritinemia, subacute upper respiratory infection, and bilateral breast nodules. Her symptoms were initially attributed to sepsis. She delivered a male infant at 28 weeks gestation by emergent cesarean section secondary to fetal distress and maternal decompensation. Subsequently, she was diagnosed with T-cell lymphoma and secondary HLH upon pathology results from her breast nodule and bone marrow biopsies. Despite treatment with multiple chemotherapeutic agents, she ultimately died of multiorgan failure 17 days after diagnosis.

Conclusions:

This case highlights the challenge of diagnosis and management of HLH in pregnancy. Patients with HLH secondary to malignancy have a particularly poor prognosis, with a mortality rate of 40% (Giard, Decker, Lai, Gill, Logan, & Fix, 2016). This patient developed hepatic and renal failure that limited available chemotherapeutic options. This case highlights the importance of considering HLH in the differential diagnosis of a patient with fever, pancytopenia, and systemic symptoms of unclear etiology. It is imperative to diagnose HLH early in order to promptly treat the underlying cause of the syndrome.

Primary Presenter: **Julia Newman**

Project Title: *Worksite Health Promotion Programs Effects on Employee Health: A Case Series*

Primary Mentor: Natalie Schwatka

Thematic Area: Public Health and Epidemiology

Abstract:

**Objective:** To examine the relationships between total worker health (TWH) programming in small businesses and worker health as measured by Health Risk Assessment (HRA). This case series uniquely compares the programming of small businesses with the efforts of business leadership to improve wellness in the workplace.

**Methods:** Six companies with both Health Risk Assessment data and Health Links business assessments were examined. Employer and employee data are reported as frequencies, with means when applicable.

**Results:** Each company varied in the comprehensiveness of their worksite health and safety promotion programming as measured by the Health Links Assessment (HLA) Benchmark scores. Overall, the companies all scored high in Organizational Support likely due to self-selection bias. There was a large variation in how companies approached developing wellness programming. As reported by the companies many faced barriers to improving TWH programming due to budget, lack of employee interest and staff capacity.

**Conclusion:** Organizations with more safety and wellness programming seem to have better HRA values than companies with less programming. Also, companies that had higher engagement benchmark scores generally had higher HRA values. There are many unique variables that contribute to an effective wellness program. Further assessment of the companies and employees is needed to determine which aspects of the wellness and safety programs are most effective.

Primary Presenter: **Tuan Dung Nguyen**

Project Title: *Soil-Transmitted Helminths Prevalence in Refugees Arriving to Colorado in 2009-2012*

Primary Mentor: Jamaluddin Moloo

Thematic Area: Public Health and Epidemiology

Abstract:

Refugees are at high risk for contracting Soil-Transmitted Helminths (STH) infections. The CDC advises presumptive pre-departure albendazole treatment to reduce STH infection rate. We retrospectively examined CDPHE data, which included results of stool O&P studies on 3,870 newly arrived refugees to Colorado (2009-2012). We examined the rate of STH infection by country and pre-departure albendazole treatment status. We excluded children under the age of 1 for whom albendazole treatment is generally contraindicated. A total of 3,870 refugees underwent screening with stool O&P; 1,668 received treatment with albendazole while 2,202 did not. 478 of 3,870 (12.33%) were positive for pathogenic parasites. Of these, a minority were pathogenic STH (55, 11.51%). Thailand and Malaysia had the highest prevalence of stool samples positive for pathogenic STH (2.12% and 2.59%, respectively) and Ethiopia had the lowest prevalence (0.39%). A lower proportion of albendazole treated patients were positive for a pathogenic STH on stool O&P relative to untreated individuals (0.78% vs. 1.91%,  $p < 0.05$ ). Among newly arriving refugees to Colorado, more than 1 in 10 was positive for a pathogenic parasite; a smaller proportion was positive for a pathogenic STH infection.



Primary Presenter: **Vivian Nguyen**

Project Title: *Modifiable Applicant Characteristics in the Otolaryngology Match*

Primary Mentor: Cristina Cabrera-Muffly

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Abstract

Objectives

To determine whether modifiable applicant characteristics such as type of research publications, letter of recommendation attributes, languages spoken, and hobbies correlate with match rates among applicants.

Study Design

Cross-sectional study.

Methods

Applications to an allopathic otolaryngology residency program between 2011 and 2013 were analyzed. Of the 1,018 applicants, 951 first-time applicants were included. Modifiable applicant characteristics were compared with match rates to determine correlation. Application characteristics included types of research publications, recommendation letter attributes, number of languages spoken, and hobbies.

Results

Increased numbers of volunteer activities and research events correlated with increased matching ( $p < 0.001$  and  $p = 0.02$ , respectively). Having at least one peer-reviewed publication or poster presentation increased match rate among applicants ( $p < 0.001$  for both). Applicants who spoke more than two languages had a decreased match rate ( $p < 0.001$ ). When evaluating hobbies, match rates were higher among applicants who listed sports and exercise ( $p = 0.01$ ), playing a musical instrument ( $p = 0.02$ ), outdoor hobbies ( $p = 0.01$ ), and travel ( $p = 0.03$ ). Having more letters of recommendation from otolaryngology chairs ( $p < 0.001$ ) and other otolaryngologists ( $p = 0.005$ ) was associated with increased match rate, while those with more letters from other surgical specialties ( $p < 0.001$ ) were less likely to match.

Conclusion

Modifiable applicant characteristics, including research activities, number of languages spoken, certain types of hobbies, and recommendation letter attributes correlate with match rates to otolaryngology residency. Knowledge of which characteristics are correlated with matching allows for more effective advising of medical student applicants. Further study is needed to correlate modifiable characteristics with resident success.

Primary Presenter: **Linh Nguyen**

Project Title: *Discover Health Project: Rural Community Outreach and Health Education Through Library-based Programs*

Primary Mentor: Jennifer Hellier

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Rural areas in Colorado have less access to health education resources than urban cities. Resources such as health outreach initiatives, museum health exhibits, and programming are valuable and beneficial to all communities. The primary overarching goal and purpose of the project is to improve access to health-related educational materials by physically bringing these resources into the communities that need them the most. This enables them to learn about pertinent health issues, how to take care of their health, and encourages more active engagement in their own health. Thus, a bilingual library-based rotating health exhibit with educational programming was developed to target high need areas, with the highest need areas identified as being primarily rural and Hispanic communities. Another long-term major goal was to increase healthcare access, literacy, and support through encouraging youth from these communities to pursue careers in the various health fields. This element was also incorporated into the project in almost all aspects. As of this writing, the exhibit has completed rotations at four libraries. The plan is to conduct pre and post surveys of the health education programming, and obtain demographic data and surveys of the exhibit as a whole to measure the effectiveness of these educational methods. The project has major potential to make positive contributions to the health literacy of these communities. However, there is currently not enough data to arrive at any conclusion regarding the true impact of the programming.

Primary Presenter: **Brett Normandin**

Project Title: *Mechanical Testing of Epiphysiodesis Screws*

Primary Mentor: Jason Rhodes

Thematic Area: Basic Biomedical Science

Abstract:

Epiphysiodesis is performed to treat leg-length discrepancies and angular deformities in children. However, when placed across a physis to modulate growth, screws can bend or break postoperatively. This study evaluated the mechanical properties of 3 different screw designs commonly used when performing an epiphysiodesis. Six 4.0-mm cannulated, fully threaded; six 4.0-mm cannulated, partially threaded; and six 4.0-mm noncannulated, partially threaded cancellous screws underwent cantilever bending and tension testing in a simulated physis. All screws were tested in simulated cancellous bone foam blocks. All testing was performed using a servo-hydraulic testing machine to determine stiffness and ultimate load. For statistical analysis, one-way analysis of variance with Tukeys honestly significant difference test in post hoc analysis was used to assess significant differences among groups ( $P < .05$ ). The noncannulated, partially threaded screws had a significantly lower stiffness than the 2 cannulated screw types in the tension test ( $P < .001$ ) and bending test ( $P < .001$ ). Additionally, the noncannulated, partially threaded screws had significantly higher ultimate load to failure than the 2 cannulated screw types in the tension test ( $P < .001$ ) and the cannulated, partially threaded screws in the bending test ( $P = .045$ ). The results indicate that noncannulated, partially threaded screws have a higher ultimate load capacity and are less stiff than both cannulated, partially threaded screws and cannulated, fully threaded screws. Surgeons should take into consideration that noncannulated, partially threaded screws are less likely to fail following epiphysiodesis.

Primary Presenter: **Lauren Oberle**

Project Title: *Pilot Prenatal Education Tool for Midwives in the Lower Napo Region of Peru*

Primary Mentor: Jennifer Bellows

Thematic Area: Global Health

Abstract:

The United Nations Millennium Development Goals (MDG) and Sustainable Development Goals (SDG) include a focus on reducing maternal mortality. By 2015, Peru showed improvements to maternal mortality rates (MMR) but was still making progress towards the MDG set in 2000. The midwives of the Lower Napo region of Peru requested an intervention to help them educate first time pregnant women, and the purpose of this project is to review the literature about prenatal education and create a tool to improve maternal mortality in this region. Many studies have been published on prenatal education both in developed and developing countries. Following literature review, the author designed a basic prenatal education curriculum designed to be given by local midwives to provide prenatal education to primigravid women. It was then distributed and taught to midwives in the Lower Napo region. The available recent literature overall shows a positive effect of antenatal education on maternal knowledge, maternal fear of childbirth and some objective measures; however, due to the lack of strong studies in this area, the overall effect of antenatal education on MMR and perinatal outcomes is still inconclusive. Much more research with strong, cohesive studies are needed on the topic in order to show the importance of this type of education. Additionally, despite delivering the tool to midwives in the Lower Napo region, the tool has not yet been utilized or evaluated due to lack of pregnancies. After further evaluation and improvements, this project has the capability of expansion to other areas of Peru and eventually randomized testing to add to the available literature.

Primary Presenter: **Kristen Ohe**

Project Title: *They are likely to be there: Family testing approach to facilitate achievement of the 1st 90 of the 90-90-90 strategy among children in Kenya*

Primary Mentor: Jayne Lewis Kulzer

Thematic Area: Global Health

Abstract:

### Background

In Kenya, less than half of all children 18 months to 14 years old with a HIV-positive parent have been tested for HIV. We examined the impact of a family-centered approach to reach children (0-14 years) with HIV testing.

### Methods

We conducted a retrospective review of clinical records among a convenience sample of 60 high-volume clinics in Kisumu, Homabay and Migori counties. We reviewed the records of adult index patients enrolled in family-centered HIV care between May–July 2015 and followed family outcomes through May 2016. Testing status, results, enrolment into care and ART initiation for those positive were abstracted. Chi-square test was used to compare the positivity proportion differences among children to outpatient and inpatient testing data from the same region and time period.

### Findings

Review of 1,937 charts led to the identification of 3,005 eligible children for testing. There were 2,848 (94.8%) children tested, among which 127 (4.5%) were HIV-positive, 100 (78.7%) were linked to care, and 85 (85%) had initiated ART by May 2016. Positive proportions among children reached through the family approach were higher than inpatient 150/8,255 (1.8%;  $p < 0.001$ ) and outpatient 2,977/18,746 (1.6%;  $p < 0.001$ ) testing proportions.

### Conclusion

The family approach leads to a high proportion of children identified with HIV in comparison to inpatient and outpatient testing and although HIV identification appears to be declining among children, it remains relatively high among this high-risk population of children and should be maximized for HIV case-finding. The family testing offers an important entry point for identification of children at high risk of HIV and the opportunity for targeted follow-up through the HIV care cascade.

Primary Presenter: **Elizabeth Patterson**

Project Title: *Uptake of routine virologic testing and predictors of virologic failure among HIV-infected children on antiretroviral treatment in western Kenya*

Primary Mentor: Lisa Abuogi

Thematic Area: Clinical Science

Abstract:

Abstract

**Background:** Long-term virologic suppression is critical for optimizing health and development among children living with HIV. Yet access to routine virologic monitoring remains limited in low- and middle-income countries. We report on viral load (VL) outcomes among HIV-infected children on antiretroviral treatment (ART) in Western Kenya.

**Methods:** Routine VL testing 6 months after initiation of ART and yearly thereafter was introduced in November 2013. We performed a case-control study among 1190 HIV-infected children  $\geq 15$  years on ART who underwent routine VL testing June 2014–May 2015. A random sample of 98 cases (VL  $>1000$  cps/mL) and 201 controls (VL  $<1000$  cps/mL) from five facilities in three high HIV prevalence counties in Kenya were followed for a minimum of 12 months. Data from patient charts were analyzed using logistic regression to determine factors associated with failure to attain virologic suppression at initial routine and follow-up VL testing among cases.

**Results:** Overall, 1190 children with a median age of 8 years underwent routine VL testing with 748 (63%) virologically suppressed. Among the 299 cases and controls, WHO stage, baseline CD4 count and time since ART initiation were not associated with failure to suppress during the follow-up period. In multivariable analysis, unsuppressed children at baseline were more likely to be male (adjusted Odds Ratio (aOR) 2.1, 95% Confidence Interval (CI) 2.1-3.6) and have had an ART regimen change (aOR 2.0, CI 1.0-3.7) than controls. Two-thirds of children 201/299 who had a follow-up VL performed, VL suppression was greater among those suppressed at baseline 126/135 (93.3%) compared to children with virologic failure at baseline 15/66 (22.7%,  $p < 0.0001$ ). Among those failing at baseline who achieved viral suppression in follow up, 12/15 (80%) were on a protease inhibitor (PI)-based regimen. In the multivariable analysis of children with follow-up VL testing, children on PI-based 2nd line regimens were 10-fold more likely to achieve viral suppression than children on first-line NNRTI-based ART (adjusted Odds Ratio [aOR] 0.1; 95%CI 0.0-0.4).

**Conclusion:** Outcomes for children with treatment failure are suboptimal, with only two thirds receiving the recommended follow-up VL testing, and less than a quarter achieving virologic suppression one year after initial routine viral load test. There is an urgent need to improve management of children living with HIV experiencing treatment failure to ensure improved long-term outcomes.

Primary Presenter: **Amelie Peisl**

Project Title: *Anti-sFlt-1 Therapy Preserves Lung Alveolar and Vascular Growth in Antenatal Models of BPD*

Primary Mentor: Steven Abman

Thematic Area: Basic Biomedical Science

Abstract:

**Rationale/Objectives:** Pregnancies complicated by antenatal stress, including preeclampsia (PE) and chorioamnionitis (CA), increase the risk for bronchopulmonary dysplasia (BPD) in preterm infants but biologic mechanisms linking prenatal factors with BPD are uncertain. Levels of soluble fms-like tyrosine kinase 1 (sFlt-1), an endogenous antagonist to vascular endothelial growth factor (VEGF), are increased in amniotic fluid and maternal blood in PE and associated with CA. Since impaired VEGF signaling has been implicated in the pathogenesis of BPD, we hypothesized that fetal exposure to sFlt-1 decreases lung growth and causes abnormal lung structure and pulmonary hypertension during infancy.

**Methods:** To test this hypothesis, we studied the effects of anti-sFlt-1 monoclonal antibody (Mab) treatment on lung growth in 2 established antenatal models of BPD that mimic PE and CA induced by intra-amniotic (IA) injections of sFlt-1 or endotoxin (ETX), respectively. In experimental PE, Mab was administered by 3 different approaches, including antenatal treatment by either IA instillation or maternal uterine artery infusion, or by postnatal intra-peritoneal injections.

**Results:** With each strategy, Mab therapy improved infant lung structure as assessed by radial alveolar count, vessel density, right ventricular hypertrophy and lung function. As found in the PE model, the adverse lung effects of IA ETX were also reduced by antenatal or postnatal Mab therapy.

**Conclusions:** We conclude that treatment with anti-sFlt-1 Mab preserves lung structure and function and prevents RVH in 2 rat models of BPD of antenatal stress and speculate that early Mab therapy may provide a novel strategy for the prevention of BPD.

Primary Presenter: **Mario Perez**

Project Title: *IN VIVO MEASUREMENT OF MOUSE ENDOTHELIAL SURFACE LAYER IN SURFACE CORTICAL MICROVASCULATURE*

Primary Mentor: Eric Schmidt

Thematic Area: Clinical Science

Abstract:

Sepsis, a systemic inflammatory response to infection, is the most common cause of in-hospital mortality in the US. Sepsis survivors often demonstrate chronic neurocognitive dysfunction. However, little is known about the mechanisms underlying the development of neurocognitive dysfunction during sepsis. We previously demonstrated that septic lung and kidney injury is mediated by degradation of the endothelial surface layer (ESL), a thick glycosaminoglycan-rich layer lining the pulmonary and glomerular microcirculation, respectively. We now postulate that degradation of the neurovascular ESL may contribute to septic neurocognitive dysfunction. To pursue this, we adapted a surgical approach to in vivo brain confocal microscopy that allows for direct visualization of the ESL in surface cortical microvasculature. We placed a cranial window in anesthetized mice. After allowing for 4 days of recovery, we re-anesthetized mice and administered an IV bolus of FITC-labeled 150 kDa dextran (excluded by the ESL), followed by TRITC-labeled 40 kDa dextran (inclusive of the ESL). Using an in-focus frame, we identified surface cortical microvessels (< 20  $\mu\text{m}$  diameter); at least 3 microvessels are typically found on a single frame. We performed in vivo confocal microscopy through the cranial window, simultaneously measuring TRITC and FITC microvessel widths. Assuming equal ESL thickness at both edges of the vessel, the ESL size is defined by one-half the difference between TRITC- and FITC-dextran vascular widths. After measurement of baseline ESL thickness, mice were injected with lipopolysaccharide (LPS) to model sepsis. ESL thickness was followed every 30 min thereafter. The baseline ESL thickness of surface cortical microvessels was 0.51  $\mu\text{m}$ , which was less than we previously observed in lungs (1.67  $\mu\text{m}$ ) but similar to that of systemic vessels (0.6 – 0.7  $\mu\text{m}$ ). Endotoxemia led to a rapid loss of ESL thickness (0.08  $\mu\text{m}$  vs. 0.71  $\mu\text{m}$  30 min after LPS or saline, respectively).



Primary Presenter: **David Pham**

Project Title: *Practice Model Destinations of Graduating Anesthesiology Resident Physicians*

Primary Mentor: Steven Zeichner

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

**Background:** Graduating anesthesiology resident physicians face both immense challenges and opportunities in today's constantly changing economic landscape. For example, changes include buyout of physician groups by private equity firms, changes in reimbursement, company model arrangements, as well as future looming changes in new payment models, like bundled payments for episodes of care and alternative payment models like Accountable Care Organizations (ACOs). Graduating anesthesiology resident physicians must navigate this economic landscape when deciding whether or not they should enter the anesthesiology job market or pursue a fellowship, and, once they eventually enter the job market, these new physicians must make informed decisions regarding their choice of employment. However, limited data currently exists regarding the job market for graduating anesthesiology resident physicians.

**Objective:** The objective of this study is to 1) provide additional data on job opportunity trends for anesthesiology resident physicians from the University of Colorado to make informed decisions regarding their careers and 2) help the anesthesiology residency program tailor its educational curriculums to better prepare resident physicians for successful careers in anesthesiology.

**Methods:** An initial survey consisting of 9 questions crafted to capture the destination of resident physicians immediately after residency training was completed by graduates of the University of Colorado Department of Anesthesiology from 2011 through 2017. Participation was voluntary, and all responses were anonymous. A second survey crafted to capture the practice models and anesthetic delivery models of the destination of both residents who entered the job market after graduating, as well as residents who pursued a fellowship after graduating is currently being finalized to provide supplemental data in conjunction with the first survey. Data from the first survey was analyzed and future data from the second survey will be evaluated for trends in the job market for anesthesiologists.

**Results:** A total of 90 graduates from the University of Colorado anesthesiology residency program from 2011 through 2017 completed the first survey, a 100 percent response rate. From 2011 through 2017, 54 percent of resident physicians from the University of Colorado anesthesiology residency program chose to enter the job market immediately after graduating from residency training, while 46 percent of resident physicians chose to pursue a fellowship. Of the resident physicians who chose to enter the job market immediately after graduating, the State of Colorado retained roughly 57 percent of resident physicians. 94 percent of the resident physicians who chose to enter the job market immediately after graduating accepted employment with a private practice. Regarding the resident physicians from the University of Colorado anesthesiology residency program who chose to pursue a fellowship, over 80 percent chose to remain at the University of Colorado. 24 percent of these resident physicians chose to enter a pediatric anesthesiology fellowship, while 22 percent chose to enter a cardiothoracic anesthesiology fellowship. Additional results are pending completion of the second survey.

Conclusion: From 2011 through 2017, a slight majority of resident physicians from the University of Colorado anesthesiology residency program chose to enter the job market immediately after graduating from residency training, as opposed to pursue a fellowship. Of the resident physicians who chose to enter the job market immediately after graduating, the majority chose to remain in Colorado. The vast majority of the resident physicians who chose to enter the job market immediately after graduating also chose to join private practices, as opposed to academic practices. Regarding the resident physicians from the University of Colorado anesthesiology residency program who chose to pursue a fellowship, the majority chose to remain at the University of Colorado. The top two most popular anesthesiology fellowships that the resident physicians chose to pursue are pediatric and cardiothoracic fellowships. The conclusions from the first survey combined with future conclusions from the second survey can be used to either support or refute claims about the anesthesiology job market and help the University of Colorado anesthesiology residency program tailor its educational curriculum to better prepare their residents to face immense challenges and opportunities in today's constantly changing economic landscape, as well as to efficaciously train them for successful careers in anesthesiology.

Primary Presenter: **Tuong Phan**

Project Title: *Soil-Transmitted Helminths in Refugees Arriving to Colorado Between 2009-2012*

Primary Mentor: Dr. Jamaluddin Moloo

Thematic Area: Public Health and Epidemiology

Abstract:

Refugees are at high risk for contracting infections from soil-transmitted helminths (STH) i.e. *Ascaris Lumbricoides*, *Trichuris trichuria*, and hookworms such as *Necator americanus*. The CDC advises presumptive pre-departure albendazole treatment to reduce STH infection rate for refugees arriving from countries with a high prevalence of STH. We retrospectively examined Colorado Department of Public Health and Environment (CDPHE) data, which included a medical history and results of stool O&P studies on newly arrived refugees to Colorado between 2009-2012. After excluding for children under the age of 1 for whom albendazole treatment is generally contraindicated for and refugees departing from countries not known to administer albendazole pre-departure, 3,870 refugees remained in our cohort. A total of 1,668 refugees (43.1%) endorsed having received treatment with albendazole, and 1,956 (50.5%) tested positive for at least one class of parasites. Of these, only 55 (1.4%) were pathogenic STH. Albendazole treatment correlated with lower incidence of STH infection (OR = 0.41, p = 0.004). No statistically significant correlation was found between gastrointestinal symptoms, gender, and age with respect to receipt of albendazole or STH infection. However, albendazole treatment also correlated with higher rates of infection with helminths whose pathogenicity remain controversial including *Blastocystis hominis* and protozoa such as *Dientamoeba fragilis* and *Entamoeba polecki* (OR = 1.81, p < 0.001).

Primary Presenter: **Paul Pokrandt**

Project Title: *Clinical Experience with Positive Expiratory Pressure for Acute Asthma Exacerbations in Children*

Primary Mentor: rakes mistry

Thematic Area: Clinical Science

Abstract:

**Objective:** This study is designed to investigate whether positive expiratory pressure (which has been previously shown to be helpful in some adult populations of adults, but has not been studied in pediatric asthmatics in the emergency department) has any benefit for children. Our goal is to describe current use of brief, intermittent positive expiratory pressure (PEP) therapy for acute asthma exacerbations in a pediatric emergency department (ED), and to determine if PEP therapy reduces asthma severity, need for additional therapies, and admission.

**Methods:** Retrospective cohort study of children 2-18 years of age presenting to a tertiary-care pediatric ED with moderate to severe asthma exacerbations from 2013-15. Children who received PEP therapy were identified, as were similarly matched controls who did not receive PEP. Demographics, baseline asthma severity, characteristics of PEP administration and clinical ED course were collected. The primary outcome was to describe current PEP use for acute asthma in the ED. Secondary outcomes included change in PAS, need for second-line therapies, disposition, and length of stay.

**Results:** 169 subjects identified: 86 in the PEP group, 83 in the control group. Groups were similar in demographics and baseline characteristics. 74.4% of PEP subjects received PEP once during ED course and 45.3% received PEP within one hour of completion of initial therapies. Mean pressure and flow for PEP delivery were  $20.7 \hat{\pm} 8.4$ mmHg and  $10.2 \hat{\pm} 0.8$ LPM, respectively. There was no difference in mean change in PAS in PEP compared to control groups ( $-0.41 \hat{\pm} 1.7$  vs.  $-0.97 \hat{\pm} 1.5$ ,  $p=0.06$ ). PEP subjects were more likely to require continuous albuterol, supplemental oxygen, admission, and had longer ED lengths of stay.

**Conclusion:** Single, brief, administration of PEP is used variably and does not improve asthma severity in children presenting to the ED with acute asthma. Future research should include a randomized controlled trial testing the efficacy of PEP, and might include a larger population to potentially identify sub-populations of pediatric patients who may benefit from PEP.

Primary Presenter: **Bill Quach**

Project Title: *Confounding bone marrow findings in lymphoma patients due to granulocyte colony stimulating factor on FDG PET/CT*

Primary Mentor: Jennifer Kwak

Thematic Area: Clinical Science

Abstract:

**Objectives:** Granulocyte colony stimulating factors (G-CSF), which are used to treat chemotherapy associated neutropenia, elevate FDG uptake in the bone marrow (BM). Elevated bone marrow uptake can be a confounding factor in the interpretation of FDG PET/CT scans in lymphoma patients. Two G-CSF agents with same mechanism of action but different serum half-lives are currently used, and a waiting period between G-CSF administration and FDG PET/CT needs to be established. Currently, there are a limited number of studies that have investigated the optimal wait time without a general consensus. The aims of this study are to differentiate the duration of bone marrow uptake in the short versus long acting G-CSF agents, identify factors that may contribute to prolonged bone marrow uptake after G-CSF administration and provide an optimal wait time between G-CSF administration and FDG PET/CT.

**Methods:** 450 lymphoma FDG PET/CT studies from a single large academic medical center from January 2014 through August 2015 were retrospectively reviewed. Scans performed within 100 days of last G-CSF administration were included for the G-CSF group, while scans performed with disease remission of at least 1 year were included as controls. G-CSF group was classified based on G-CSF formulation as long acting (pegfilgrastim) or short acting (filgrastim). Studies with new disease burden and patients receiving high dose filgrastim for stem cell mobilization were excluded. FDG uptake in the bone marrow was measured quantitatively with standardized uptake value (SUV) measurements and qualitatively by visual assessment of FDG uptake in the bone marrow compared to liver and blood pool by three blinded, nuclear radiologists. Regression was used to estimate the association between time since G-CSF administration and uptake.

**Results:** 172 scans met inclusion criteria with 75, 74 and 23 exams recruited to control, pegfilgrastim and filgrastim groups, respectively. Average bone marrow uptake (SUV<sub>mean</sub>) in the control group was 1.3 compared to 2.1 and 1.8 in the pegfilgrastim and filgrastim groups. The mean interval days between G-CSF administration and FDG PET/CT was 22.6 days for pegfilgrastim and 20.8 days for filgrastim groups. The number of days required to reach control group BM SUV<sub>mean</sub> for pegfilgrastim was 27 days compared to 14 days for filgrastim. Primary factors significantly affecting BM FDG uptake were age ( $p=0.02$ ) and number of days since G-CSF administration ( $p<0.001$ ). Probability of bone marrow uptake being visually less than liver uptake was 60% at 30 days in the pegfilgrastim group and 75% at 10 days in the filgrastim group. Inter-rater reliability was good for radiologist visual judgement of BM uptake (ICC = 0.83).

**Conclusion:** Pegfilgrastim, with its longer serum half-life, results in longer durations of elevated BM FDG uptake compared to filgrastim. As the first study to combine both quantitative and qualitative measurements of BM FDG uptake, our data supports an optimal wait time between G-CSF administration and FDG PET/CT of 27 to 30 days for pegfilgrastim and 10 to 14 days for filgrastim.

Primary Presenter: **Kevin Quackenbush**

Project Title: *The novel tankyrase inhibitor (AZ1366) enhances irinotecan activity in tumors that exhibit elevated tankyrase and irinotecan resistance*

Primary Mentor: Todd Pitts

Thematic Area: Basic Biomedical Science

Abstract:

**Background:** Dysregulation of the canonical Wnt signaling pathway has been implicated in colorectal cancer (CRC) development as well as incipient stages of malignant transformation. In this study, we investigated the antitumor effects of AZ1366 (a novel tankyrase inhibitor) as a single agent and in combination with irinotecan in our patient derived CRC explant xenograft models.

**Results:** Six out of 18 CRC explants displayed a significant growth reduction to AZ1366. There was one CRC explant (CRC040) that reached the threshold of sensitivity (TGII  $\geq$  20%) in this study. In addition, the combination of AZ1366 + irinotecan demonstrated efficacy in 4 out of 18 CRC explants. Treatment effects on the WNT pathway revealed that tankyrase inhibition was ineffective at reducing WNT dependent signaling. However, the anti-tumor effects observed in this study were likely a result of alternative tankyrase effects whereby tankyrase inhibition reduced NuMA levels.

**Materials and Methods:** Eighteen CRC explants were treated with AZ1366 single agent or in combination for 28 days and treatment responses were assessed. Pharmacokinetic (AZ1366 drug concentrations) and pharmacodynamic effects (Axin2 levels) were investigated over 48 hours. Immunohistochemistry of nuclear  $\beta$ -catenin levels as well as western blot was employed to examine the treatment effects on the WNT pathway as well as NuMA.

**Conclusions:** Combination AZ1366 and irinotecan achieved greater anti-tumor effects compared to monotherapy. Activity was limited to CRC explants that displayed irinotecan resistance and increased protein levels of tankyrase and NuMA.

Primary Presenter: **Nathan Riechers**

Project Title: *Working to end teenage obesity*

Primary Mentor: Janet Meredith

Thematic Area: Clinical Science

Abstract:

Engaging Teens in Weight Management Conversations:

A Qualitative Community-Based Participatory Research Study

Background and Objectives:

Childhood obesity is an ever-growing health epidemic, with rates tripling over the past few decades and a disproportionate burden found in neighborhoods surrounding the University of Colorado Anschutz Medical Campus in Aurora.<sup>1, 8,13</sup> In order to address this rising health concern, this research team studied the experiences of teens and providers who had weight management conversations in the healthcare setting using survey and teenage focus groups. Our objective is to learn how providers might lead more effective conversations with teenagers regarding weight. We hope this research will improve strategies for weight-related dialogue between teenagers and their healthcare providers and, ultimately, lead to improved health outcomes in the community and beyond. The direct input from teenagers makes this project novel, with equivalent studies lacking this input.

Methods:

This study was performed via community-based participatory research (CBPR), in which research design and implementation were done in conjunction with a teenage advisory board (TAB). After collaborating with the TAB to create a focus group protocol, teenagers were recruited from local schools to participate in focus groups, during which they shared their experiences of weight management conversations with healthcare providers and made suggestions for improvements. Focus groups were audio-recorded, transcribed, then qualitatively analyzed using open coding by three separate coders. Then, electronic and paper surveys were distributed to local providers about their experiences discussing weight with teenage patients. The protocol was IRB exempt: 13-1670.

Results:

Two separate sets of gender-separated focus groups have been conducted so far, the first of Latina/Latino teens and the second of mixed race. All participating teens believed it was important for health care providers to know how to conduct weight management conversations with their teenage patients and most had had experiences with such conversations in the past. The following five main themes were derived from the focus groups: 1) make opening the conversation more comfortable by first getting to know the teenager, 2) discover the teens individual goals and motivations for health and weight in order to better tailor advice, 3) provide a written weight management plan composed of a few steps at a time which include concrete and individualized suggestions, 4) provide realistic expectations for weight loss, and 5) support them with frequent follow up and verbal encouragement. Provider survey is in progress.

## Conclusions:

While teens agree that the conversations they have with their health care provider are a very important part of their weight management journey, they have many ideas for how these can be improved. Based on the provider survey, providers do bring up the topic, but feel that their conversations could use much improvement. They are interested in learning teen-approved recommendations. Surveys for providers are currently in progress. Further research will be performed to reach a wider pool of teens through surveys, and to study the effects of training providers on the efficacy of their conversations in actual practice.



Primary Presenter: **Kelli Robertson**

Project Title: *Exploiting Translation Inhibition: Antitumor efficacy of SVC112 in Preclinical Models of Colorectal Cancer*

Primary Mentor: John Tentler

Thematic Area: Basic Biomedical Science

Abstract:

Exploiting Translation Inhibition: Antitumor Efficacy of SVC112 in Preclinical Models of Colorectal Cancer

Authors:

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Background:

Colorectal cancer (CRC) ranks third in new cases and cancer deaths in the U.S. annually. The current frontline treatments for metastatic CRC (mCRC) are ineffective for an appreciable proportion of patients and induce significant toxicities. Thus, there is an urgent need for the development of new therapeutic strategies. Translation is a novel, underutilized target for cancer therapeutics. Eukaryotic elongation factor 2 (eEF2) is often overexpressed in CRC causing upregulation of translation, upon which CRC may be dependent. Therefore, it may be possible to differentially target CRC cells by inhibiting translation. SVC112 is a novel inhibitor of translation and the parent molecule of SVC112 has been shown to lock eEF2 onto the ribosome. As such, this agent may be effective against mCRC by blocking translation of key oncogenes such as c-myc which is overexpressed in mCRC.

Methods:

Forty-four CRC cell lines were exposed to SVC112 in vitro and CellTiter Glo ATP quantification was used to determine sensitivity or resistance based on IC<sub>50</sub> values. Select sensitive and resistant cell lines were further validated with clonogenic assays to evaluate for sustained response. Immunoblotting was performed to assess levels of c-myc, survivin, and cyclin D1 in response to treatment with SVC112. Amino acid incorporation was measured using the Click-IT AHA kit protocol. eEF2 mRNA levels were ascertained from RNA seq data while cell cycle effects were determined by flow cytometry. Gene set analysis was done using the GSEA software, Version 2.0.1. Two patient-derived tumor explants were selected based on BRAF and KRAS mutational status and treated in vivo with SVC112.

Results:

A subset of CRC cell lines were found to be sensitive to SVC112 in vitro, and notably, there was a trend towards increased eEF2 expression, BRAF mutations, and myc-overexpression and greater

responsiveness to SVC112. Interestingly, expression of RP20, a component of the 40S ribosomal subunit, was amplified in sensitive cell lines whereas expression was decreased in resistant cell lines. In sensitive cell lines, c-myc was downregulated by SVC112 in a dose-dependent manner whereas in resistant cell lines c-myc levels were not affected. Moreover, SVC112 caused a reduction of amino acid incorporation in sensitive cell lines compared to resistant cell lines. Likewise, the sensitive cell lines exhibited dose-dependent effects on the cell cycle with SVC112 whereas resistant cell lines did not. SVC112 demonstrates synergy with 5-FU in sensitive cell lines. In models and dosing conditions tested thus far, SVC112 has not demonstrated clear single agent efficacy in vivo.

#### Conclusions:

SVC112 demonstrates anti-cancer effects in a subset of CRC cell lines, indicating translation machinery may be an effective druggable target in CRC. There is an apparent correlation between eEF2 levels, BRAF mutations, and RP20 expression with sensitivity which could be used as a selection strategy for sensitive tumors moving forward. SVC112's ability to decrease amino acid incorporation and deplete c-myc in sensitive cell lines substantiates the proposed mechanism of action. Further experiments are needed to investigate the mechanism of resistance and whether this is related to anti-eEF2 exposure or a mechanism unrelated to eEF2 escape. Further analysis of SVC112 ribosomal engagement is ongoing. SVC112 has demonstrated synergistic effects with 5-FU, a standard chemotherapeutic for CRC, indicating its potential efficacy in combination therapy. Currently, combination studies with SVC112 and 5-FU are underway in vivo.

Primary Presenter: **Christopher Robertson**

Project Title: *The Continuing Need for Ethics Education in Pediatric Residencies: An Innovative Online Approach Using Brightspace*

Primary Mentor: Jackie Glover

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

**Background:** The need for continued Ethics training in graduate medical education is becoming increasingly recognized. While both residents and educators are interested in ethics education in residency, there is a paucity of research and a lack of published curricula. In addition, many barriers to implementing ethics curricula during residency have been identified. In light of these issues, we are currently in development of an online-based ethics curricula for pediatric residents at the University of Colorado using the online educational platform, Brightspace.

**Methods:** First, a literature review was conducted to glean insights in how to structure an ethics curriculum for residents, what content to deliver, analyze current available, published curricula and identify barriers to effective implementation of our own curriculum. Research suggests case-based curricula with emphasis on specialty- specific ethical issues and ethical issues relevant to all specialties are most effective in improving resident-based outcomes such as interest, confidence and knowledge levels. Second, we describe the ongoing process of developing our online ethics curriculum using Brightspace as our primary educational platform.

**Discussion:** Available evidence suggests that there is a need and desire for ethics training in graduate medical education. Ethics education in residency is effective at improving resident-centered outcomes, however, there is currently significant variability in ethics curricula among residency programs, and there are many identified barriers to implementing ethics education during residency. Informed by this research, we are currently developing an online ethics curricula for pediatric residents using the online platform, Brightspace, with plans to evaluate the performance of this unique approach to incorporating ethics training within graduate medical education.

Primary Presenter: **Ivan Rudenko**

Project Title: *Role of paraventricular nucleus' neuronal lipoprotein lipase in hepatic metabolism.*

Primary Mentor: Nguyen Eckel

Thematic Area: Basic Biomedical Science

Abstract:

Hepatic insulin resistance and increased hepatic glucose production (HGP) are key to the pathogenesis of type 2 diabetes (T2DM). The autonomic nervous system (ANS) can regulate both hepatic glucose and lipid metabolism. However, the mechanisms related to hepatic neuronal inputs remain unclear. If elucidated, these mechanisms offer a novel target for T2DM interventions. We have previously shown that despite obesity, mice with a pan-neuronal lipoprotein lipase (LPL) deficiency display improved glucose tolerance, reduced HGP and altered activity of energy-sensing neurons in the paraventricular nucleus of the hypothalamus (PVN). Since the PVN is associated with hepatic glucose metabolism, we hypothesized that neuronal LPL may sense lipids to regulate peripheral energy homeostasis. In present study, using stereotaxic viral delivery of cre-coding virus in LPL<sup>flox/flox</sup> mice, we specifically targeted the LPL knock-out to the neurons of the PVN to generate PVN nLPL- mice. PVN nLPL- and control mice (PVN nLPL+) showed no difference in body weight, whole body adiposity, food intake or activity. However, 2 hr IP Glucose tolerance tests (GTT) revealed a trend towards improved glucose tolerance in the PVN nLPL- mice. While we did not observe a difference in hepatic triglyceride accumulation, there was a trend toward decreased hepatic expression of the lipogenic gene *Scd-1* in the PVN nLPL- mice. Our findings suggest that neuronal LPL in the PVN may play a role in neuronal lipid sensing, which in turns regulates hepatic lipid flux and glucose metabolism.

Primary Presenter: **Eric Ryan**

Project Title: *Increased Naloxone Training and Prescription Through an EMR-Based Intervention*

Primary Mentor: Jamie Baker

Thematic Area: Public Health and Epidemiology

Abstract:

Americas "opioid crisis" is well-documented and commonly discussed in the political, medical, and legal realms with alarmingly increasing numbers of Americans becoming addicted to prescription opioid medications and, on many occasions, heroin. Alongside the increase in addiction has been an increase in opiate-caused overdose and death. Although much of the discussion has been placed on decreasing excess prescription of opioid medications, there has been recent emphasis and research placed on various harm-reduction strategies including prescribing naloxone to high-risk individuals. Additionally, it is known that most overdoses occur in the presence of others, and that having naloxone more widely dispersed and easily accessible can limit fatal overdose among groups in which multiple persons use opiates.

We started this quality improvement project with the goal of identifying patients who were receiving high-risk prescriptions of opioid medications and providing them with a prescription and training for a naloxone auto injector. The template used in the electronic medical record system at the PFC Floyd K. Lindstrom Veterans Affairs Outpatient Clinic in Colorado Springs, Colorado was changed such that no note for an outpatient office visit could be finalized and signed without calculating and acknowledging the daily morphine milligram equivalents prescribed to the patient.

We sought to provide naloxone and training to patients whose daily morphine milligram equivalents met or exceeded 50. Over the course of our implementation and trial, 18 patients at such a dosage were identified. Prior to our intervention, only 6 of these patients had received naloxone prescription and training, compared to 13 patients at the conclusion.

Primary Presenter: **Natasha Sanchez Cristal**

Project Title: *Child Life Reduces Distress & Improves Family Satisfaction in the Pediatric Emergency Department*

Primary Mentor: Jennifer Staab

Thematic Area: Clinical Science

Abstract:

### Objective

The aim of this study is to evaluate the effects of Child Life Specialist (CCLS) intervention during routine peripheral intravenous (PIV) placement in the emergency department (ED). We hypothesized that CCLS involvement during routine PIV placement would reduce procedure-related distress, decrease pain, increase procedure efficiency, and improve family satisfaction with care.

### Methods

A convenience sample of 78 children, ages 3 to 13 years, requiring PIV placement for their treatment at a pediatric ED received either standard care or CCLS intervention for PIV placement. Child pain and distress, procedure efficiency, and family satisfaction were compared between the two groups.

### Results

Children receiving CCLS intervention reported an average reduction in pre- to post-procedural pain by nearly an entire point on the Wong-Baker Faces scale while children in the control experienced an increase in pain ( $-0.953 \hat{\pm} 0.378$ ,  $p=0.004$ ). Children receiving CCLS intervention also exhibited fewer negative behaviors during PIV placement as indicated by a lower Childrens Emotional Manifestation Scale (CEMS) score ( $-3.98 \hat{\pm} 1.34$ ,  $p=0.004$ ). Parents and providers of children receiving CCLS intervention perceived less pain and distress during the procedure, and CCLS intervention was associated with greater family satisfaction with care received during their ED visit.

### Conclusions

This study demonstrates that Child Life intervention can have an impact on important outcomes in the pediatric ED such as pain, distress and visit satisfaction. Child Life Specialists play a crucial role in helping to improve and develop best practices for pain management during painful hospital procedures.

Primary Presenter: **Stephanie Sargent**

Project Title: *The Data Validation and Status of Change in Smokers in Cañon City*

Primary Mentor: Jaime Baker

Thematic Area: Clinical Science

Abstract:

### Background

Tobacco use is associated with significant morbidity and mortality within the US and worldwide. It plays a significant role in the development of multiple cancers, cardiovascular disease and chronic obstructive pulmonary disease. Despite these increased risks, there continues to be 30 million new smokers each year. New and continued tobacco use is seen within the Sangre de Cristo Family Practice, indicating a need to validate the smoking status of patients in the EMR and innovate the conversation and treatment around tobacco cessation to increase the health and quality of life of these patients.

### Methods

This was a data validation study of 129 current smokers at the Sangre de Cristo Family Practice. Patients were given a verbal questionnaire via telephone to verify their smoking status and assessed their current willingness to change their smoking status based on the Stages of Change Model. This was accomplished by asking patients if they were currently willing, trying or not interested in smoking cessation.

### Results

Out of the 129 smokers listed in the EMR, 49 patients were included in this data validation study (n=49). The remaining 80 patients either left the practice, were deceased, had no updated contact information, or didn't answer the questionnaire. Of those 49 patients, 18 patients were no longer smoking and 31 patients confirmed their smoking status. The accuracy of smoking documentation was 63%. Further patients were stratified based on the Stages of Change Model. When asked, 18 patients (37%) had quit, 4 patients (8%) were actively trying to quit, 10 patients (20%) were willing to quit, 6 patients (12%) were willing to cut back, and 11 patients (22%) had no interest in changing their smoking status.

### Conclusions

Smoking documentation was 63% accurate in the EMR, indicating a need for updated information in the EMR for its use in quality improvement projects. Further, patients were stratified by their willingness to quit smoking and were questioned about prior quit attempts, cohabitants smoking status, and their reasons for continued smoking despite learning the benefits of cessation. The data collected can be used to determine if patients Stage of Change alters their smoking cessation success rate.

Primary Presenter: **Emily Schmidt-Beuchat**

Project Title: *The Increasing Frequency of Hate-Crimes in the United States following the 2016 Presidential Election and their impact on Minority Adolescent Mental Health: A Case Study*

Primary Mentor: Tai Lockspeiser

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

There is overwhelming evidence that exposure to violence and trauma can lead to post-traumatic stress, depression, anxiety, aggression, and behavioral problems in youth and adolescents. Traumatic events that have been studied in the past include terrorist attacks, ongoing political conflicts, and natural disasters. This case study looks at a 15 year old African-American Muslim male with immigrant parents who presented to clinic citing 2 months of clinically significant somatic symptoms explained only by the patients high anxiety. After revealing a constant fear for his safety, he acknowledged that his symptoms began at the time of the 2016 Presidential Election and a subsequent race-related hate-crime experienced by his close friend. The literature reviewed in this case study suggests that this election and the associated rise in frequency of bias-motivated crime in the US is a serious trauma for minority adolescents with the ability to negatively impact both their physical and mental health.2-5, 7, 10-14, 17-22, 24-29, 31- 38, 40-44, 50 Implications for clinicians include recognizing this at risk group in order to increase screening, treatment, and overall cultural competency.



Primary Presenter: **Anna Schreiber**

Project Title: *Evaluation of TAK-264, an antibody-drug conjugate in pancreatic cancer cell lines and patient-derived xenograft models*

Primary Mentor: Todd Pitts

Thematic Area: Clinical Science

Abstract:

**Background:** Antibody-drug conjugates (ADCs) are an emerging technology consisting of antibody, linker, and toxic agent, which have the potential to offer a more targeted therapeutic approach than standard chemotherapy regimens. ADCs selectively bind to antigens expressed in tumor environments. An emerging target for the treatment of pancreatic cancer is guanylyl cyclase C (GCC). GCC is a transmembrane G protein receptor found on the apical surface of intestinal enterocytes. It plays an important role in GI homeostasis. GCC is highly expressed in various colorectal carcinomas as well as adenocarcinomas of the upper GI tract. The objective of this study was to determine the antitumorigenic activity of TAK-264, an investigational ADC that targets GCC with a monomethyl auristatin E payload.

**Experimental Procedures:** The antiproliferative effects of TAK-264 was assessed in a panel of eleven pancreatic cancer cell lines with various molecular backgrounds. Additionally, ten unique pancreatic ductal adenocarcinoma (PDAC) cancer patient-derived xenograft (PDX) models were treated with TAK264 and the efficacy was determined. Tumor size was evaluated twice per week by caliper measurements. Sensitivity to TAK-264 was defined based on tumor growth inhibition that was statistically significant when compared to the vehicle control. Baseline levels of GCC were analyzed by IHC/immunoblotting and RT-PCR on PDX models and cell lines. Immunoblotting was performed to evaluate the effects of TAK-264 on downstream effectors.

**Results:** GCC protein expression was analyzed by immunoblotting in normal versus tumor tissue; a marked increase in GCC expression was observed in tumor tissue when compared to matching normal tissue. The in vitro experiments demonstrated a range of responses to TAK-264 in an SRB assay. Eight of the ten PDAC PDX models demonstrated a statistically significant tumor growth inhibition when compared to the vehicle control. Immunoblotting demonstrated an increase in phosphorylated-HistoneH3 in two cell lines and in the PDAC PDX models treated with TAK-264, indicating a DNA damage response. The analysis of GCC protein expression in normal versus tumor tissue has shown a marked increase in GCC expression in tumor tissue when compared to matching normal tissue. There was no correlation between baseline levels of GCC and response to TAK-264 in either PDX or cell line models.

**Conclusions:** TAK-264, an ADC targeting GCC, has good growth suppression activity in pancreatic cancer cell lines and in pancreatic PDX models. These findings support a hypothesis that further investigation of ADC targeting GCC may lead to novel therapeutic modalities for pancreatic cancer.

Primary Presenter: **Myra Sendelweck**

Project Title: *Associations Between Indoor Tanning and Substance Use Among Colorado High School Students*

Primary Mentor: Robert Dellavalle

Thematic Area: Public Health and Epidemiology

Abstract:

Indoor Tanning Associations with Substance Use among Colorado High School Students

The World Health Organization classifies ultraviolet (UV) radiation as a group 1 carcinogen and deems using UV emitting tanning devices a risk factor for melanoma, basal cell carcinoma, and squamous cell carcinoma.<sup>1</sup> Nonetheless, about one in five adolescents have used a UV tanning bed in their lifetime.<sup>2</sup>

A growing national body of evidence links indoor tanning (IT) to other risky health-related behavior among adolescents.<sup>3,4</sup> Motivation for IT is multifactorial including physiological and psychological factors. For example, IT and steroid use may both stem from appearance enhancing motivations.<sup>5</sup> Data also implicate addictive physiologic pathways in IT which may be similar to those of substance use.<sup>6</sup> Knowledge of these similarities can help guide the clinician. Studies examining these associations within states such as Colorado that lack age restrictions for IT may foster regulation of this carcinogenic activity. This study analyzes results from a Colorado high school student survey to examine state level associations between substance use and IT.

Methods

The Healthy Kids Colorado Survey (HKCS) collected self-reported health data from Colorado public schools. The University of Colorado Denver's Institutional Review Board approved the study. The 2013 HKCS included participation from over 220 schools and 40,000 students in 21 regions. Questionnaires including an item on the frequency of IT use reached 12,671 high school students. Items regarding substance use examined the type and frequency of use.

Sample-based survey weighting was used to support inferences about Colorado public high schools not surveyed. Weighted percentage of students reporting substance use from each population (tanners and non-tanners) was calculated along with their 95% confidence intervals (CI). Univariate analysis utilized weighted frequencies and percentages for each variable and outcome of interest. Measures of effect were calculated with odds ratios (OR) as determined through un-adjusted and adjusted logistic regression modeling. Un-adjusted logistic regression was performed to evaluate the potential association between the use of individual substances and indoor tanning practices (Table 1). Adjusted logistic regression models were then fit using a stepwise process of forward selection. This analysis was stratified by gender as univariate results showed that females were more likely than males to engage in indoor tanning practices (Table 2).

## Results

A total of 12,144 survey respondents answered the question “During the past 12 months, how many times did you use an indoor tanning device such as a sunlamp, sunbed, or tanning booth?” The univariate analysis showed that females were approximately twice as likely to engage in IT as males (unadjusted OR, 2.0; 95% CI, 1.6-2.5;  $P < .001$ ). The multivariate analysis identified any lifetime use of steroids as the variable most strongly associated with IT (adjusted OR, 5.5; 95% CI, 3.4-9.1;  $P < .001$ ). In males, this potential association was even stronger (adjusted OR, 7.1; 95% CI, 3.6-14.0;  $P < .001$ ). Any 30 day alcohol consumption and marijuana use were also associated with IT, as were select lifetime illicit drug use.

## Discussion

In addition to the inherent adverse health effects of IT, this study provides evidence for a potential association between substance use and IT practices in Colorado high school students. Identifying risky health behavior patterns may facilitate preventive health efforts to reduce IT among adolescents. For example: a clinician treating a patient who indoor tans may also choose to assess for steroid use, particularly in male adolescents. Studying these ramifications is an important public health discussion that can aid in promoting wellness. These findings may be used in clinic settings to broaden patient risk assessments and tailor counselling.

Primary Presenter: **Rachel Sewell**

Project Title: *Curricular exposure and student knowledge related to lesbian, gay, bisexual, and transgender healthcare topics at the University of Colorado School of Medicine*

Primary Mentor: Steven Lowenstein

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

**Background:** According to national data and One Colorado, lesbian, gay, bisexual, and transgender (LGBT) patients receive lower quality healthcare compared to their cisgender heterosexual counterparts. Nationally, most medical schools devote little curriculum time to LGBT healthcare topics. We hypothesized that students in the Physical Therapy (PT), Physician Assistant (PA) and Doctor of Medicine (MD) programs have inadequate exposure to LGBT topics in their curricula and that this would be reflected in their limited knowledge of LGBT health-related topics.

**Methods:** We surveyed 34 PT, 25 PA, and 43 MD students in their clinical years, using validated survey items and knowledge questions from published LGBT patient studies. Data analysis focused on three outcome variables: exposure to 16 curriculum items; knowledge of relevant LGBT health topics; and self-reported confidence addressing LGBT patients healthcare needs. Survey responses were summarized descriptively and statistical differences among programs were investigated using ANOVA. Free-text questions were included to gather students perspectives and recommendations.

**Results:** The survey response rate was 26%. Student-reported curriculum exposure (means) varied by program: PT (0.709), MD (1.31), and PA (1.93) ( $p < 0.001$ ). Knowledge scores (mean % correct) were significantly lower in the PT program (30.40%) compared to the MD (59.41%) and PA (51.70%) programs ( $p < 0.001$ ). There was a moderately strong correlation ( $r = 0.455$ ,  $p < 0.001$ ) between reported curricular exposure and percent correct on knowledge questions. Despite their limited curricular exposure and knowledge, 86% and 84% of students reported confidence in their ability to provide comprehensive healthcare to patients whose sexual orientation and gender identity differed from their own, respectively. Free-text comments indicated that students recognized the importance of respectful and sensitive care of LGBT patients and the gaps in their knowledge.

**Conclusions:** Students in these three programs report limited or no curricular exposure to critical LGBT healthcare topics, and this was reflected in their limited knowledge. Students recognize the gaps in their knowledge and want to improve their curricula. Schools have an opportunity to provide appropriate curriculum coverage of this important arena of patient care.

Primary Presenter: **Nichole Shaw**

Project Title: *Regenerative Medicine Approaches for the Treatment of Pediatric Physeal Injuries*

Primary Mentor: Karin Payne

Thematic Area: Basic Biomedical Science

Abstract:

The physis, or growth plate, is a cartilaginous region at the end of children's long bones that serves as the primary center for longitudinal growth and characterizes the immature skeleton. Musculoskeletal injury, including fracture, infection, malignancy, or iatrogenic damage, has risk of physeal damage. Physeal injuries account for 30% of pediatric fractures and may result in impaired bone growth. Once damaged, cartilage tissue within the physis is often replaced by unwanted bony tissue, forming a "bony bar" that can lead to complications such as complete growth arrest, angular or rotational deformities, and altered joint mechanics. Children with a bony bar occupying <50% of the physis usually undergo bony bar resection and insertion of an interpositional material, such as a fat graft, to prevent recurrence and allow the surrounding uninjured physeal tissue to restore longitudinal bone growth. Clinical success for this procedure is <35% and often the bony bar and associated growth impairments return. Children who are not candidates for bony bar resection due to a physeal bar occupying >50% of their physis undergo corrective osteotomy or bone lengthening procedures. These approaches are complex and have variable success rates. As such, there is a critical need for regenerative approaches to not only prevent initial bony bar formation but also regenerate healthy physeal cartilage following injury. This review describes physeal anatomy, mechanisms of physeal injury, and current treatment options with associated limitations. Furthermore, we provide an overview of the current research using cell-based therapies, growth factors, and biomaterials in the different animal models of injury along with strategic directions for modulating intrinsic injury pathways to inhibit bony bar formation and/or promote physeal tissue formation. Pediatric physeal injuries constitute a unique niche within regenerative medicine for which there is a critical need for research to decrease child morbidity related to this injurious process.

Primary Presenter: **Brian Shreve**

Project Title: *Identifying Frequent Emergency Department Users Through a Statewide Health Information Exchange*

Primary Mentor: Roberta Capp

Thematic Area: Public Health and Epidemiology

Abstract:

### Introduction

Care coordination services (CCS) provided to frequent emergency department (ED) users at the time of visit have shown to decrease ED recidivism. Actively identifying and characterizing this population during their ED visit remains challenging as some frequent users utilize multiple hospitals and single hospital electronic health records (EHR) do not capture this data.

### Methods

Quality improvement study conducted at a large urban academic ED with approximately 100,000 ED annual visits from June 2015 - August 2015 used Student Patient Navigators (SPNs) 7 days a week, 24 hours a day, to provide CCS for patients. SPNs utilized the EDs EHR and the state wide Health Information Exchange (HIE) website in real-time to identify frequent ED users defined as  $\geq 3$  ED visits over 6 months. We used a multivariable logistic regression to assess the association of patient characteristics and multiple hospital utilization.

### Results

Of the 2,346 patients approached, 1,856 (79%) agreed to conduct a socio-health screening. Mean age was 40 ( $\pm 15.12$ ) years old and 1,140 (61%) were females. We identified 339 (18%) frequent ED users through the single hospital EHR and 495 (26%) frequent ED users through the state wide HIE, ( $p < .0001$ ). Among frequent ED users, patients were less likely to use multiple hospitals if they were Black [ref=White (OR 0.46; 95% CI, 0.27-0.79)], had no insurance or Medicaid [ref= private (OR= 0.22; 95% CI, .06-.72); (OR=0.37; 95% CI: 0.27-0.79)] or had a primary care provider (OR= 0.51; 95% CI: 0.33-0.80).

### Conclusion

State wide HIE use resulted in a greater number of individuals being identified as frequent ED users by utilizing information collated from multiple EDs allowing more patients to benefit from CCS.

Primary Presenter: **Yonaton (Yoni) Siegel-Richman**

Project Title: *Incidental Findings in Student Ultrasound Models*

Primary Mentor: Tsoi Kendall

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

As ultrasonography continues to become integrated into undergraduate medical education, there have been concerns raised about the use of volunteer models and the ability to maintain patient privacy during scanning sessions. To date, there have been no reports on how instructors should manage situations in which incidental findings are made during educational ultrasonography sessions. We present three different examples of incidental findings that occurred at our institution and the various approaches taken by the instructors. Furthermore, we outline an approach that can be utilized by other medical schools to better maintain patient confidentiality.

Primary Presenter: **William Silkworth**

Project Title: *Central Visual Oscillopsia: Case Report and Review of the Literature*

Primary Mentor: Wylie Kluger

Thematic Area: Clinical Science

Abstract:

**Objective:** The aim of this study is to present results of an investigation of repetitive Transcranial Magnetic Stimulation (rTMS) applied over primary visual cortex, or area V5/MT, for the treatment of central visual oscillopsia due to traumatic brain injury.

**Presentation of case:** A 57-year old man reported visual oscillopsia following a traumatic brain injury. Symptoms were presumed to be of cortical origin given normal eye movements and eye stability and normal peripheral vestibular function. Furthermore, he reported oscillopsia with visual imagery during eye closure. Occipital lesions damaging white matter connections identified on MRI were suspected to be the cause of the central oscillopsia.

**Review of the literature:** Central oscillopsia, defined as oscillopsia originating from cortical dysfunction, has rarely been reported in the literature. Pathologies associated with oscillopsia in reported cases include neuromyelitis optica spectrum disorder, stroke, migraine without infarction, and psychological trauma.

**Methods:** rTMS was applied in successive rounds of therapy to the left extrastriate visual motion area V5/MT, to bilateral V5/MT, and to bilateral striate visual area V1. The primary outcome measure was dynamic visual acuity. Secondary outcome measures included gaze stabilization testing and subjective improvement as noted by interviews of the patient following each rTMS session.

**Results:** Results from gaze stabilization testing and dynamic visual acuity testing revealed no difference between pre- and post-treatment with rTMS. The patient reported symptomatic improvement in large amplitude oscillations but stated that smaller amplitude oscillations were not affected.

**Conclusions:** The patients reported improvement in large but not small amplitude oscillopsia suggests a treatment effect from rTMS. However, subjective improvement was not reflected in dynamic visual acuity testing results. Further investigation of rTMS as a possible treatment modality for central oscillopsia is warranted, and objective measures of improvement are also needed.



Primary Presenter: **Lynelle Smith**

Project Title: *IDO1/2 & TDO2 IMMUNE REGULATION IN EPITHELIAL OVARIAN CARCINOMA*

Primary Mentor: Jennifer Richer

Thematic Area: Clinical Science

Abstract:

Purpose:

Serous epithelial ovarian cancer metastasizes by direct seeding to form disseminated tumors within the peritoneal cavity and has an extremely poor clinical outcome with a 46.5% five-year survival rate. Considering this method of metastasis, resistance to anoikis (detachment-induced cell death) is a critical factor in the progression of this disease. We previously demonstrated that triple-negative breast cancer (TNBC) upregulates tryptophan-2,3-dioxygenase (TDO2), a rate limiting enzyme in tryptophan catabolism, under anchorage-independent conditions or by stimulation with an NFkB stimulating cocktail (IL1-b, TNFa). Indoleamine-pyrrole 2,3-dioxygenase (IDO1) is also a rate-limiting enzyme in the tryptophan catabolism pathway that converts tryptophan to kynurenine and both TDO2 and IDO1 can be expressed by tumors. Kynurenine, a metabolite of tryptophan catabolism acts in an autocrine fashion through the aryl hydrocarbon receptor to provide anti-apoptotic signals that enhance survival under anchorage independent conditions. Through paracrine action, kynurenine can suppress anti-tumor cytotoxic T-cell function. We hypothesize that tryptophan catabolism promotes ovarian cancer progression through these two mechanisms, primarily through TDO2.

Methods:

We mined the publically available Tothill Ovarian Cancer patient cohort (n=293) for correlations between TDO2 or IDO1 and ovarian cancer outcomes. The anoikis resistant serous ovarian cancer cell lines HEY, OV-1847, OVCA-420 & OVCA-433 were used to test levels of enzymes involved in tryptophan catabolism in vitro at baseline, in attached versus suspended conditions and following NFkB stimulation with IL1-b and TNFa. Three enzymes in the pathway; TDO2, IDO1 & Kynureninase (KYNU), were quantified by qRT-PCR and immunohistochemistry (IHC). Using a cytokine/chemokine array and follow-up ELISA, we also analyzed factors secreted by ovarian cancer cells surviving in suspension culture as compared to attached.

Results:

In the ovarian cancer patient cohort, high TDO2 significantly correlated with higher stage disease ( $p=0.0033$ ), increased recurrence rates ( $p<0.0001$ ) and lower survival rates ( $p=0.0034$ ), whereas IDO1 did not show any significant correlations. The expression of tryptophan catabolizing enzymes was significantly increased in the suspended condition when compared to attached and following NFkB stimulation. Ovarian cancer cell lines in suspension culture increased levels of IL-1a, G-CSF, MIF and IL-6 on arrays, and IL-6 was confirmed by ELISA.

Conclusions:

Data mining of patient specimens indicates that TDO2 may be the more relevant enzyme responsible for tryptophan metabolism in ovarian cancer since high TDO2 is correlated with higher clinical stage, disease progression and in recurrent chemoresistant disease, suggesting that TDO2 may facilitate disease progression. Tryptophan catabolizing enzymes are elevated in ovarian cancer cells surviving under anchorage independent condition or inflammatory stimuli. Based on these findings, we believe that clinical trials targeting TDO2 in addition to IDO may be warranted for serous ovarian cancer.

Primary Presenter: **Andrew Sprowell**

Project Title: *The Design and Implementation of a Depression Registry for Primary Care*

Primary Mentor: Danielle Loeb

Thematic Area: Public Health and Epidemiology

Abstract:

Registries are fundamental to the success of population health initiatives to improve care and outcomes for patients, including those with depression. The purpose of this article is to describe the design and clinical implementation of a depression registry as part of a collaborative care for depression (CDD) intervention at two large academic outpatient internal medicine practices. The primary objective of the registry was to identify and track patients with depression and monitor antidepressant therapy. Secondary objectives of the registry were to assist in addressing pay for performance and value-based reimbursement metrics for depression screening and remission. The registry design and variables for inclusion in the registry were defined with input from clinicians, institutional leadership, and data analysts. For implementation, specific clinical workflows were established and responsible team roles were designated.

Primary Presenter: **James Sze**

Project Title: *Use of Video Media for the Instruction of Physical Examination in the Preclinical Years*

Primary Mentor: Todd Guth

Thematic Area: Bioethics, Humanities, Arts, and Education

Abstract:

Physical examination remains a core clinical skill of any practicing physician, both for the purposes of connecting with patients, and as one of the most reliable and readily-available diagnostic tools clinicians have. Medical education at all levels, from national accrediting and licensing bodies to individual medical school continue to emphasize competencies in physical examination, with training based in face-to-face instruction, standardized patient sessions, and limited clinical experiences prior to the clinical training years. The dropping cost of video production, paired with widely-available and popular web-hosting platforms have made this a golden age for the use of video and other web-based media in medical education. Moreover, the use of these resources may complement resource and time-constraints medical schools face in teaching core clinical skills. We developed an instructional video series under the University of Colorado School of Medicines Foundations of Doctoring Curriculum to supplement the physical examination instruction, to determine if application of this media was a feasible resource that students would take advantage of. In post-distribution surveys following the students first OSCE, we found that responding students received the videos exceptionally well as a supplement to the standard curricular resources provided to them.

Primary Presenter: **Claudia Temmer**

Project Title:

*Treating Decompression Sickness: Collaboration between a Military Training Site and Community Hospital*

Primary Mentor: Tracy Cushing

Thematic Area: Clinical Science

Abstract:

Background: High-altitude flight simulation familiarizes military trainees with the symptoms of hypoxia to prepare them for emergency situations. Decompression sickness (DCS) can occur as a result of these simulations. In cases when ground-level supplemental oxygen does not resolve symptoms, hyperbaric oxygen (HBO) therapy is indicated. Many military hyperbaric chambers have been closed because of cost reductions, necessitating partnerships with community hospitals to ensure access to treatment.

Materials and Methods: This article describes the unique arrangement between a community hospital in Colorado and a military training site to treat DCS cases emergently. We gathered cost data from the community hospital to estimate and compare the cost of providing HBO therapy in the hospital versus a standalone chamber similar to the former military hyperbaric chamber.

Results: Since the closure of the military hyperbaric chamber, the community hospital treated an estimated 50 patients with DCS requiring HBO therapy attributed to high-altitude flight simulation between October 2003 and April 2015. Cost to the institution providing HBO treatment varies widely on the basis of patient volume. Assuming a volume of five treatments, per-treatment cost at a standalone center is \$95,380. In contrast, per-treatment cost at the hospital assuming a volume of 1,000 treatments commensurate with the hospital's ability to bill for other services is \$698 per treatment.

Conclusion: The cost analysis demonstrates that the per-treatment cost of operating a standalone HBO therapy center may be greater than 100 times that of operating a center at a community hospital, suggesting the arrangement is beneficial to the military.

Primary Presenter: **Joe Torres**

Project Title: *Bone Marrow Mononuclear Leukocytes from Unique Hyperoxia Tolerant Rats Have Increased Heme oxygenase-1 (HO-1) Expression*

Primary Mentor: Oberle Repine

Thematic Area: Basic Biomedical Science

Abstract:

Acute Respiratory Distress Syndrome is a highly fatal acute lung injury that kills many Americans on a yearly basis. Many lab models use hyperoxia as a model for ARDS. The Repine lab has discovered rats that are resistant to the effects of long-term hyperoxia exposure. These rats have been demonstrated to have increased expression of HO-1 in their alveolar macrophages, an inducible enzyme that metabolizes pro-oxidant heme groups into less injurious biliverdin and is thought to have extensive anti-oxidant effects. These tolerant rats were also found to display systemic protection against aging, obesity, anxiety, and memory loss, although the mechanism is unclear. In this study, HO-1 and NO expression in the mononuclear leukocytes that the alveolar macrophages derive from were studied to discover if these additional systemic benefits may be related to the mononuclear leukocytes from which the mononuclear leukocytes derive. It was demonstrated that mononuclear leukocytes from hyperoxia-tolerant rats had increased expression of HO-1 and decreased expression of NO compared with control rats, suggesting that there has been a systemic adaptation in mononuclear cells that may help explain the other beneficial features of tolerant rats. These findings may have implications for future pharmacological targets as well as enhance our understanding of the benefits of hypoxia-tolerant rats.

Primary Presenter: **Mi Tran**

Project Title: *The Impact of Maternal Malaria Infection During Pregnancy on Infant Illness: A Cohort Study in Kenya*

Primary Mentor: Rosemary Rochford

Thematic Area: Global Health

Abstract:

**Background:** Malarial infection during pregnancy (MiP) is associated with adverse maternal and fetal outcomes. While prior studies have analyzed the effects of malaria infection during pregnancy on low birth weight and immune response, few studies have examined the impact of MiP on infant illness.

**Methods:** A prospective cohort study was conducted at Chulaimbo Hospital in Kenya where 370 pregnant women attending antenatal clinic were enrolled, resulting in an infant cohort of 220 infants who were followed from birth to 24-months. Infants born to mothers who were HIV positive were excluded resulting in a total of 147 infants included in the final analysis. Statistical analysis was performed using SAS to analyze the association between MiP and infant illness.

**Results:** The median time of infant follow-up was 12-months with 71 (46.41%) diagnoses of upper respiratory tract infections for infants born to mothers with MiP, 4 (2.61%) diagnoses of lower respiratory tract infections (LRTI), 14 (9.15%) diagnoses of GI illnesses, 22 (14.38%) diagnoses of malaria, and 42 (27.45%) diagnoses of other illnesses within 24-months of follow-up. Of the non-MiP infants 44 (39.29%) were diagnosed with URTI, 3 (2.68%) with LRTI, 16 (14.29%) with GI illness, 12 (10.71%) with malaria, and 37 (33.04%) with other illnesses. In univariate analyses, these results were statistically significant ( $p < 0.05$ ); however, no significant differences were found ( $p > 0.05$ ) after adjustment for mothers age, infant age at follow-up, infant sex, and low birth weight.

**Conclusion:** The results of this study showed no significant differences in infant illness for MiP infants and non-MiP infants after adjusting for confounding variables. Additional studies examining the multifactorial impact of MiP, low birth weight, maternal gravidity, and infant co-morbidities among other potential confounding variables on infant infections and health outcomes remains a research necessity in order to determine the strongest predictive factors for infant infections and effective prevention strategies.

Primary Presenter: **Minh Trinh**

Project Title: *External Validation of a Permanence Calculator: Optimizing Inferior Vena Cava Filter Utilization*

Primary Mentor: Thor Johnson

Thematic Area: Clinical Science

Abstract:

Increasing interest in efficient and safe use of retrievable inferior vena cava filters (rIVCF) led to the development of a likelihood of permanence calculator. We aimed to evaluate the performance of this calculator at our institution by validating parameters used by this calculator. A prospectively acquired rIVCF database was reviewed from 2011-2015 for all retrievable filters placed; sex, age, history of venous thromboembolism (VTE), presence of malignancy, and presence of neurological disease were collected. Likelihood of filter permanence was calculated using the existing method and compared a) rIVCF declared permanent and b) rIVCF that were removed. We generated estimates of permanence risk for our patient sample and compared these estimates to the permanence calculator estimates. Wilcoxon-Mann-Whitney tests were used to test for differences in continuous variables and Fisher's exact tests were used to compare the distribution of categorical variables by permanence status. We used a type I error rate of 0.05 for all tests. Of 337 rIVCF devices placed during the study period, 171 (50.7%) were declared permanent. The permanence likelihood, calculated using the permanence calculator, was higher in the permanent group than the removed group ( $p < 0.05$ ). Permanence was significantly underestimated by the permanence calculator ( $p < 0.05$ ) and this underestimation did not vary by permanence status ( $p > 0.05$ ). Our modified algorithm found age (relative risk [RR], 1.01; 95% confidence interval [CI], 1.01-1.02), presence of malignancy (RR, 1.37; CI, 1.11-1.68), presence of neurological disease (RR, 1.56; CI, 1.12-2.16), and an indication of AC failure (RR, 1.74; CI 1.25-2.43) to be the strongest predictors of filter permanence ( $p < 0.05$ ). The existing calculator estimated higher permanence likelihood for patients with rIVCF declared permanent; however, it consistently underestimated rIVCF permanence likelihood in our population. This highlights the need to validate and adjust the parameters to improve clinical utility of the calculator.



Primary Presenter: **Alexandra Tsoi**

Project Title: *Chinese Perspectives on Aging and End-of-life Care*

Primary Mentor: Hillary Lum

Thematic Area: Global Health

Abstract:

**Purpose:** As the percentage of elderly in China's population increases, there is an ever-growing demand for affordable, compassionate, and centralized care. This study aims to understand how the fears and values of elderly Chinese in Shenyang, China affect their quality of life, their perceived healthcare and community service needs, their views on planning for future illness and death and their perspectives concerning end-of-life decision making,

**Methods:** Researchers conducted 16 interviews with Chinese over 65 years of age with the help of a translator following an interview guide. The interviews were transcribed and translated then qualitatively analyzed using the content analysis methods and organized into themes, subthemes, and exemplary quotes.

**Results:** Participants valued being perceived as contributing members of society. Loss of function due to age or illness was regarded with fear and depression. They also valued a supporting community and strong relationships with friends, family, and neighbors. Participants expressed a desire for increased availability of compassionate and affordable care, specifically regarding nursing homes, hospice, and community services for the elderly. Most were reluctant to make individual plans for future healthcare needs as this type of planning was deemed unnecessary and stressful. When immediate end-of-life decisions needed to be made the autonomy of the patient as well as the input of the family were of key importance.

**Conclusions:** This study is a part of the ongoing investigation concerning the needs and beliefs of an aging Chinese population in regards to healthcare, community support, and end-of-life care. As the Chinese government looks to implement programs for their elderly population, current research regarding these needs will be crucial for success. Understanding the importance of family in decision making as well as the growing importance of autonomy, the fear and values that influence their actions, and the pricelessness of compassion from healthcare workers, family, and community all contribute to the understanding of what steps need to be taken to improve the quality of life and care for elderly Chinese.

Primary Presenter: **Ngoc Vu**

Project Title: *A cross-sectional study of knowledge, attitudes, and practices surrounding exclusive breastfeeding in Dhulikhel Hospital, Nepal*

Primary Mentor: Jennifer Bellows

Thematic Area: Global Health

Abstract:

Abstract

Background

Although many studies assessed rates of malnutrition and stunting in children under five years of age in Nepal, few studies have addressed exclusive breastfeeding (EBF) as a contributing factor.

Research/Aim

Our research was conducted to determine knowledge, attitude and intentions to exclusively breastfeed of pregnant Nepali women attending the antenatal clinic at Dhulikhel Hospital.

Methods

A cross-sectional survey was conducted among 302 pregnant women that attended the antenatal clinic at Dhulikhel Hospital in Nepal. The quantitative questionnaire was created based on a survey used to evaluate barriers to EBF in Zimbabwe with questions added based on the Behavioral Theory Model. Data set is categorical data and was analyzed using the Fischers Test for statistical significances.

Results

Knowledge of exclusive breastfeeding recommendations, beliefs of ability to create sufficient breastmilk, and perception of necessity for supplementation influenced mothers decision to terminate exclusive breastfeeding despite to World Health Organization recommendations. 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 in this Nepali community. The belief that supplemental food or formula is necessary was demonstrated to have an influential impact on cessation of exclusive breastfeeding within the first six months. Intervention through health-care workers such as physicians or midwives can influence the intentions of exclusive breastfeeding in pregnant women in Nepal.

Primary Presenter: **Brian Walsh**

Project Title: *DEFAULT MODE NETWORK ACTIVITY: TESTING FOR ASSOCIATION WITH EXTERNALIZING BEHAVIOR PROBLEMS WITH AND WITHOUT LIMITED PROSOCIAL EMOTION*

Primary Mentor: Joseph Sakai

Thematic Area: Clinical Science

Abstract:

Abstract

**Purpose of Study:** Adolescents with externalizing behavior problems (conduct disorder (CD) and substance use disorders (SUD)) are a source of large social and economic costs. Such adolescents sometimes display high levels of limited prosocial emotion (LPE) and recent work supports that the presence of LPE identifies a distinct subgroup of youths with CD. We sought to test whether activity of the default mode network (DMN), a functional brain network involved in self-reflective thought, empathy, and foresight, is associated with these disorders.

**Methods:** We collected 6 minutes of resting state functional magnetic resonance imaging for 20 patients with CD/SUD and LPE, 21 patients with CD/SUD without LPE, and 22 controls (all males 14-18 years). We used independent component analysis, a data-driven approach, to identify networks (i.e., clusters of voxels which activate together across time). We then utilized a standard template and spatial correlation to select the DMN. We tested: (1) whether the 3 groups differed significantly in DMN activity, (2) whether DMN activity was associated with severity of externalizing behavior problems within patients, and (3) whether DMN activity was associated with LPE trait severity within patients.

**Results:** Three-group comparisons revealed differences in one cluster including portions of the posterior cingulate cortex (PCC) and precuneus (Brodmann area (BA) 31). Subsequent two-group comparisons showed that both patient groups had significantly less activation in this cluster compared with controls. Our within-patient analysis showed that severity of externalizing behavior problems was negatively associated with activity of a cluster in the ventral and dorsal anterior cingulate areas (BA24/32), and positively associated with activity in a cluster within the PCC. Finally, within patients, severity of LPE traits was negatively associated with activity in a cluster of the inferior parietal lobule (BA40).

**Conclusions:** While both patient groups, regardless of LPE, showed less activity in the DMN (BA31), higher levels of LPE trait were associated with a distinct pattern of hypo-activity within patients. Further investigation may lead to better treatment of these disorders.

Primary Presenter: **Chelsea Walter**

Project Title: *The Youth Community Health Awareness Partnership: A community-based initiative to address problematic alcohol use within the community of refugees from Burma*

Primary Mentor: Janet Meredith

Thematic Area: Global Health

Abstract:

**BACKGROUND:** Since the installation of a military junta in 1962, minorities in Burma have fled their homeland to escape killings, torture, rape, landmines and forced labor. Many settle in East Denver and Aurora where they struggle to adjust to life in a foreign culture. Personal and community health are crucial priorities to address with refugees that must face the complexity of the American healthcare system during transition.

**METHODS:** Beginning with the work completed by Hoerauf, Holtstaul, and Ovrutsky (CUSOM Class of 2017), we developed a multi-phase community based participatory research (CBPR) project in collaboration with the refugee community from Burma residing in Aurora/Denver. Phase 1, Community Assessment and Issue Identification, involved solidifying a community partnership, identifying priority health issues, and conducting a formative needs assessment. Monthly meetings with the Youth Advisory Board (YAB), a group of young adults and teenagers from Burma, have guided this project. The YAB selected risky alcohol use as the priority health issue facing their community. The project is currently in Phase 2, Intervention Mapping, which involves conducting a formal, publishable needs assessment. We will be conducting semi-structured interviews of roughly 30 community members. Participants will be recruited using a snowball sampling technique, and interviews will be conducted by one medical student and one translator (a community member that has gone through training). The interview data will be analyzed using Immersion Crystallization methodology. Phase 3, Intervention Development and Evaluation, will consist of using the information gathered in Phase 1 and 2 to create, implement and evaluate a sustainable, culturally appropriate intervention to address risky alcohol use in this disadvantaged community.

**RESULTS:** To date, we have held 24 meetings with the YAB and over 20 meetings with local organizations. 19 formative community surveys were collected and 3 key informant interviews were held. Initial results point to the vulnerability of the refugee population, the scarcity of culturally appropriate resources for alcohol abuse, and the urgency of addressing problematic alcohol use.

**CONCLUSIONS:** This project has already made significant progress in developing meaningful relationships with members of a local community that is incredibly underserved. Challenges faced include intense time commitment, multiple submissions for IRB approval in order to best acquire information from a unique community that communicates in person and with trusted individuals. Because of the equal partnership model of CBPR and the investment made on both ends, this partnership will result in a sustainable, longitudinal project that will effect meaningful and culturally effective change for the refugee community from Burma.

Primary Presenter: **Annie Wattles**

Project Title: *Endometrial Ablation: Failure Rates and Risk Factors*

Primary Mentor: Jaime Arruda

Thematic Area: Clinical Science

Abstract:

## INTRODUCTION

Abnormal uterine bleeding accounts for up to one-third of outpatient visits to gynecologists, and can significantly impact women's quality of life. Endometrial ablation is approved specifically for the treatment of heavy regular menstrual bleeding (menorrhagia) but has been widely adopted for "off-label" use to treat several other conditions. It is not clear whether the use of endometrial ablation for indications other than menorrhagia may increase the failure rate of endometrial ablation. The rates of ablation failure that are quoted in the literature vary widely and risk for ablation failure is not well understood. This project aimed to identify the rates of failure at University of Colorado Hospital and to determine whether certain risk factors increase likelihood of failure. Ablation failure is currently defined in the literature as repeat ablation or subsequent hysterectomy. The need for additional medical management post-ablation was also considered. Authors hypothesized that ablation failure rates would be higher than published rates given the use of ablation at the University to treat conditions other than its primary indication of heavy menstrual bleeding, including irregular uterine bleeding, polyps, and dysmenorrhea.

## METHODS

Data was collected through retrospective chart review of any woman who underwent endometrial ablation at the University from 2011 through the present (n=100). Demographic information, gynecologic history, procedural details, and follow-up data were collected systematically into a secure database in REDCap. Statistics consisted of calculated rates with chi-square analysis to determine statistical significance between outcome groups for each given potential risk factor.

## RESULTS

Successful ablations requiring no further treatment occurred at a rate of 68% of all cases. Surgical failures (repeat ablation or hysterectomy) occurred at a rate of 16%, with 15% undergoing hysterectomy, meeting similar rate to large published studies. Patients requiring additional medical therapy also occurred at a rate of 16%. Risk factors that significantly increased risk of ablation failure considering both surgical and medical groups included preoperative diagnosis of menorrhagia ( $p=0.027$ ), metromenorrhagia ( $p = 0.048$ ), and polyps ( $p=0.037$ ), and having an IUD in place at time of procedure ( $p = 0.01$ ). Type of ablation was also significant for the surgical failure group ( $p = 0.028$ ).

## CONCLUSIONS

Contradictory to authors hypothesis, surgical ablation failure rates at University are similar to published failure rates, and furthermore, having an ablation for an "off-label" indication made it more likely that a woman would be satisfied with the procedure, suggesting a possible placebo effect of undergoing

a procedure. Heavy menstrual bleeding and polyps made it more likely that a woman would require additional treatment, highlighting the challenge of treating these symptoms. Age at time of ablation, obesity, and other factors were not associated with failed outcome.

Primary Presenter: **Eric Webster**

Project Title: *Working to End Teen Obesity*

Primary Mentor: Janet Meredith

Thematic Area: Clinical Science

Abstract:

Engaging Teens in Weight Management Conversations:

A Qualitative Community-Based Participatory Research Study

Background and Objectives:

Childhood obesity is an ever-growing health epidemic, with rates tripling over the past few decades and a disproportionate burden found in neighborhoods surrounding the University of Colorado Anschutz Medical Campus in Aurora.<sup>1, 8,13</sup> In order to address this rising health concern, this research team studied the experiences of teens and providers who had weight management conversations in the healthcare setting using survey and teenage focus groups. Our objective is to learn how providers might lead more effective conversations with teenagers regarding weight. We hope this research will improve strategies for weight-related dialogue between teenagers and their healthcare providers and, ultimately, lead to improved health outcomes in the community and beyond. The direct input from teenagers makes this project novel, with equivalent studies lacking this input.

Methods:

This study was performed via community-based participatory research (CBPR), in which research design and implementation were done in conjunction with a teenage advisory board (TAB). After collaborating with the TAB to create a focus group protocol, teenagers were recruited from local schools to participate in focus groups, during which they shared their experiences of weight management conversations with healthcare providers and made suggestions for improvements. Focus groups were audio-recorded, transcribed, then qualitatively analyzed using open coding by three separate coders. Then, electronic and paper surveys were distributed to local providers about their experiences discussing weight with teenage patients. The protocol was IRB exempt: 13-1670.

Results:

Two separate sets of gender-separated focus groups have been conducted so far, the first of Latina/Latino teens and the second of mixed race. All participating teens believed it was important for health care providers to know how to conduct weight management conversations with their teenage patients and most had had experiences with such conversations in the past. The following five main themes were derived from the focus groups: 1) make opening the conversation more comfortable by first getting to know the teenager, 2) discover the teens individual goals and motivations for health and weight in order to better tailor advice, 3) provide a written weight management plan composed of a few steps at a time which include concrete and individualized suggestions, 4) provide realistic expectations for weight loss, and 5) support them with frequent follow up and verbal encouragement. Provider survey is in progress.

## Conclusions:

While teens agree that the conversations they have with their health care provider are a very important part of their weight management journey, they have many ideas for how these can be improved. Based on the provider survey, providers do bring up the topic, but feel that their conversations could use much improvement. They are interested in learning teen-approved recommendations. Surveys for providers are currently in progress. Further research will be performed to reach a wider pool of teens through surveys, and to study the effects of training providers on the efficacy of their conversations in actual practice.



Primary Presenter: **Hannah Wellman**

Project Title: *Patient Satisfaction and Safety in the Denver Health Epilepsy Monitoring Unit*

Primary Mentor: Christensen White

Thematic Area: Clinical Science

Abstract:

Efficient identification of seizure etiology leads to faster treatment and better outcomes for epilepsy patients. The use of video EEG and 24-hour monitoring in the inpatient Epilepsy Monitoring Unit (EMU) has been found to assist in diagnosis in over 75% of EMU admissions. However, in order to make the diagnosis, EMU protocols often involve reduction or discontinuation of anti-epileptic medications, precipitating a higher occurrence of seizures in the EMU. Due to this high-risk situation, patient safety is paramount; an estimated 4-10% of patients in the EMU experience an adverse event during their stay. Previous studies have examined safety protocols and provider perception of safety in the EMU, but none have directly surveyed patients. We designed a survey to study patient satisfaction and perception of safety during an EMU stay. We expected to see high levels of satisfaction overall with nursing staff versus other providers due to the relatively long amounts of time spent with patients and families. Preliminary data shows lower patient satisfaction with doctors than other providers and lack of confidence in the necessity of an EMU stay. We hope to act upon these findings by developing a more effective doctor-patient communication paradigm and providing clear information about the importance of EMU studies to diagnostics.

Primary Presenter: **Sally Westcott**

Project Title: *Student-Run Clinic Effect on Emergency Department Utilization (SCEEDU)*

Primary Mentor: Kari Mader

Thematic Area: Public Health and Epidemiology

Abstract:

Background

Emergency department (ED) congestion is a widely-accepted problem that has continued to worsen over several decades. In addition to affecting patient care, there are significant financial implications to the overuse of emergency services. While this problem is multifactorial, one commonly-cited cause is the use of emergency departments for conditions which can be appropriately managed in primary care settings. Background studies on the topic have yielded mixed results, but almost all point to improving access to regular primary care services as a potential remedy. Student-run free clinics (SRFC) have become more prevalent at medical education centers across the country and aim to provide care to those with limited means. As one of these safety-nets, the DAWN clinic serves the indigent population of Aurora, Colorado and is interested in measuring the effect of providing primary care on local emergency services utilization.

Objective

The purpose of this study is to measure the effect of receiving primary care services at the DAWN clinic on University of Colorado ED utilization before and after enrollment. We predict that enrollment at the DAWN clinic for primary care services will reduce all-cause ED visits.

Methods

We used DAWN Clinics Electronic Health Record to generate a list of patients who established care at the DAWN clinic and crossmatched this list with the University of Colorado's Emergency Department data to compile a de-identified list of DAWN patients who have been seen at the University of Colorado ED. A paired t-test was used to analyze the raw number of emergency department visits to DAWN Clinic visits. We then applied a regression model to examine clinically relevant covariates.

Results

Patients that had ED visits both before and after enrollment in the DAWN clinic showed a marked reduction in average ED visits/month, from an average of 0.350 to 0.070. The total number of ED visits was also decidedly reduced, from 150 total visits in the time before DAWN enrollment to 29 after establishing care.

Conclusions

Patient enrollment at the DAWN clinic effectively reduced all-cause ED visits.

Primary Presenter: **Sarah Williams**

Project Title: *Food Access in Elyria-Swansea: a Review*

Primary Mentor: Rita Lee

Thematic Area: Public Health and Epidemiology

Abstract:

Elyria-Swansea, a neighborhood in northeast Denver, is a food swamp. The neighborhood lacks a grocery store, whose large purchasing power allows residents to purchase fresh produce at affordable prices. However, the area is saturated with convenience stores and fast food chains. Elyria-Swansea residents suffer from worse health outcomes than other Denver neighborhoods, which is attributable to many environmental factors. However, the neighborhood's poor health outcomes cannot be attributed to a simple lack of access to healthy, affordable food. Many community members in Elyria-Swansea live below the federal poverty line and face critical decisions when making any purchases; they are not able to experiment with novel fresh ingredients that may not satiate all family members. In addition, as the community is majority Hispanic with many recent immigrants primarily from Mexico, it is critical that the food each family prepares and eats is culturally relevant. Therefore, residents choose to go outside of their neighborhood to find food that is affordable and aligned with their families' desires. The forces that drive food choice can be summarized as culture, price, proximity, and knowledge/empowerment; simply addressing the proximity issue by making food easier to access will likely have little effect on health outcomes.

Primary Presenter: **Amy Winstead**

Project Title: *Long Acting Reversible Contraception in Colorado: Demand, Barriers to Use, and Solutions*

Primary Mentor: Mark Deutchman

Thematic Area: Public Health and Epidemiology

Abstract:

Access to long acting reversible contraception (LARC) can dramatically reduce unintended pregnancy. This study is a survey of the current use of LARC in Colorado clinics and of provider interest in additional resources to increase utilization of LARC. A standardized survey was sent to 182 rural and safety net clinics. The survey asked about the use of IUDs and implants, barriers to use, and the providers desire for additional training. The survey demonstrated that LARC services are being provided at many of the rural and safety-net clinics across Colorado. The primary barriers that prevent these services from reaching populations in need include lack of provider training and the perceived expense of LARC methods. There is a desire for written materials to support providers offering these services, and an online module may be an effective way to disseminate this information. Updated information regarding insurance coverage of LARC and low-cost options for uninsured patients may help dispel misunderstandings that persist about the cost associated with LARC methods.

Primary Presenter: **Andrew Wolf**

Project Title: *Exploring inhibitory circuits in the midbrain in behaving animals*

Primary Mentor: Gidon Felsen

Thematic Area: Basic Biomedical Science

Abstract:

Complex neural circuitry is required for the precise selection, generation, and coordination of movements. While this circuitry underlies the essential function of the motor system, our understanding of its mechanics remains limited. The study of movement-related decisions represents a tractable process to examine in order to understand features of these complex circuits. The superior colliculus (SC), a highly-conserved layered midbrain structure in mammals, is well positioned to play an important role in sensorimotor decisions, especially with regard to orienting movements of the head, neck, eyes, and limbs, as it integrates multimodal sensory input and has substantial motor outputs. While glutamatergic neurons that mediate motor output for orienting movements comprise the largest subpopulation of neurons in the deep functional subdivision of the SC, the role of inhibitory GABAergic neurons, which comprise up to 30% of the neurons in the region, in modulating the output of these glutamatergic projection neurons is poorly understood. Functional inhibition has been demonstrated in slice studies and SC GABAergic neurons are generally fast-spiking and over 80% are spontaneously active. Based on these electrophysiological properties, these neurons may provide tonic inhibition to the glutamatergic neurons responsible for mediating contralateral movements. Critically, due to technical limitations in investigating specific neuron types in vivo, the activity of GABAergic neurons has not yet been directly investigated in behaving animals.

Primary Presenter: **Lisa Wolff**

Project Title: *Implementing a practical tool to screen for hereditary cancer in primary care settings*

Primary Mentor: Mark Deutchman

Thematic Area: Clinical Science

Abstract:

Family cancer history represents the effects of shared genetic, environmental, and behavioral factors, which have important implications for risk of different types of cancer. Therefore, a patient's medical and family history provides essential information when screening for genetic syndromes that could increase the chance of developing cancer.

Two such syndromes include hereditary breast and ovarian cancer syndrome (HBOC), which increases the risk of mainly breast and ovarian cancer and Lynch syndrome, which increases the risk for mainly colorectal cancer. The genetic applications of these two syndromes, along with familial hypercholesterolemia, have been labeled "Tier 1" by the US Centers for Disease Control and Prevention because the guidelines have been fully validated, supported by systematic review. Even in absence of a hereditary syndrome, breast, colorectal, and ovarian cancers are some of the most common cancers where family history is recognized as a major risk factor.

Our Cancer Risk Tool (CRiT) will be a computer-based tool that assesses familial risk for HBOC and Lynch syndrome and will apply evidence-based guidelines to create an individualized prevention and screening plan. An algorithm based on Tier 1 guidelines will analyze the family cancer history and calculate patient risk based on number of family members diagnosed with cancer, types of cancer diagnosed, age of onset of cancer, sex of affected family members, affected family members' relationship to patient, and the combinations of different types of cancer within a family. This project hopes to capture quantitative and qualitative patient feedback and insight into the experience of using the screening tool to help refine the usability of the tool and improve patient experience.

Primary Presenter: **Thomas Wong**

Project Title: *Upsloping lateral sourcil: A radiographic finding of hip instability*

Primary Mentor: Mary Jesse

Thematic Area: Clinical Science

Abstract:

Aims

To define and validate a new radiographic finding associated with hip instability known as the upsloping lateral sourcil (ULS).

Materials and Methods

316 patients were reviewed for lateral center edge angle, the presence of a ULS, and generalized joint laxity. The ULS was defined on anteroposterior pelvic radiographs as a caudal-to-cranial inclination of the middle-to-far lateral aspect of the acetabular sourcil with loss of lateral acetabular concavity.

Results

The prevalence of the ULS increased with the degree of under-coverage as defined by LCEA. Within the normal coverage group, hips with a ULS had smaller LCEAs than those without ULS (29° vs 32°,  $p < 0.001$ ). Among hips with a ULS, 59.00% had generalized joint laxity. The association between the ULS and generalized joint laxity was statistically significant ( $p < 0.01$ ).

Conclusion

The ULS is seen with higher prevalence in patients with clinical hip laxity and radiographically decreasing LCEA and may serve as an adjunctive finding in patients presenting with hip pain and instability.

Clinical Relevance

\* ULS is a new secondary radiographic finding associated with acetabular undercoverage and generalized laxity.

\* ULS may help to characterize patients with borderline hip dysplasia and laxity that fall outside conventional imaging criteria for dysplasia.

Primary Presenter: **Mengjie Wu**

Project Title: *Role of IgG Subclasses in Mucosal Defense of Streptococcus pneumoniae and Antibody Response to Pneumovax and Prevnar 13 in HIV Positive and Negative Patients*

Primary Mentor: Edward Janoff

Thematic Area: Basic Biomedical Science

Abstract:

**Purpose:**

Two vaccines that are available to prevent infections with the bacterial pathogen, Streptococcus pneumoniae, may elicit different immunological responses, particularly in the lung, the primary site of pneumococcal infections. Although both contain capsular polysaccharides, the 13-valent Pneumococcal Conjugate Vaccine (PCV13) demonstrated clinical protection against pneumonia in older adults, whereas the 23-valent Pneumococcal Polysaccharide Vaccine (PPSV23) does not. Differences in the predominant subclasses of IgG (IgG1 and IgG2) elicited by the two vaccines and preferential transfers of subclasses across the epithelial layer into the lungs may underlie the differences in efficacy.

**Methods:**

We vaccinated 11 healthy adults with varying smoking status and characterized bronchial alveolar fluids (BAL) and blood samples. Using enzyme linked immunosorbent assays, the quantities of IgG1 and IgG2 in these samples were measured before and after vaccination.

**Summary of results:**

Serum and BAL fluids with PPSV23 vaccination contained an increased level of both IgG1 and IgG2. In the serum, the ratio of capsular polysaccharide-specific IgG2:IgG1 demonstrates a higher level of IgG2 relative to IgG1 both before and after vaccination (62.1 and 35.7, respectively). The ratio of capsular polysaccharide specific IgG2:IgG1 is decreased by 43% in serum while in the BAL fluids the ratio of total IgG2:IgG1 is increased by 43% (0.105 to 0.150) after vaccination.

**Conclusion:**

We conclude that despite a predominance of specific IgG2 prior to vaccination, PPSV23 elicits a more robust IgG1 response relative to IgG2 in the serum. The decreased of IgG2 relative to IgG1 in the BAL fluids may support an increased selective transport for IgG1 from serum across the epithelial layer to the lungs, where pneumococcal pneumonia begins, and antibody defense is most important.



Primary Presenter: **Alexander Yale**

Project Title: *Drugs of Abuse and Novel Psychoactive Substances at Outdoor Music Festivals in Colorado*

Primary Mentor: Andrew Monte

Thematic Area: Clinical Science

Abstract:

BACKGROUND:

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Drugs of abuse (DOA) are widely used in the United States and are ubiquitous at outdoor music festivals. Attendees at music festivals are at high-risk for novel psychoactive substance (NPS) use, which is becoming more prevalent worldwide. No U.S. studies have employed an qualitative approach to investigate the etiologies of both traditional DOA and NPS use amongst music festival attendees.

OBJECTIVES:

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The objective of this study was to improve understanding of the knowledge, attitudes, beliefs, and practices of festival attendees using NPS and DOA.

METHODS:

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We conducted semi-structured interviews of 171 attendees during the Sonic Bloom and Arise music festivals in Colorado in 2015 and 2016. Discrete variables were summarized with descriptive statistics. The anonymous, multi-domain interview documented the knowledge, attitudes beliefs, and practices underlying DOA use, which were analyzed with qualitative methods.

RESULTS:

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We enrolled 171 participants that endorsed DOA use at the festivals. Most were experienced DOA users, who perceived minimal risks associated with DOA and NPS use. Nearly all unanimously reported normalization of DOA at music festivals. Participants popularly cited empathogenic, entactogenic, and entheogenic effects of DOA as their primary motivations for use. NPS use was endorsed by 39.8% (n = 68) of respondents, all of whom identified as being experienced DOA users.

CONCLUSIONS:

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This population of novel psychoactive substance users is primarily composed of experienced drug users that endorsed use because of low cost, minimal perceived risk, accessibility, and normalization of drug use at music festivals.

Primary Presenter: **Michael Yang**

Project Title: *The Design and Implementation of a Depression Registry for Primary Care*

Primary Mentor: Danielle Loeb

Thematic Area: Clinical Science

Abstract:

Registries are fundamental to the success of population health initiatives to improve care and outcomes for patients, including those with depression. The purpose of this article is to describe the design and clinical implementation of a depression registry as part of a collaborative care for depression (CDD) intervention at two large academic outpatient internal medicine practices. The primary objective of the registry was to identify and track patients with depression and monitor antidepressant therapy. Secondary objectives of the registry were to assist in addressing pay for performance and value-based reimbursement metrics for depression screening and remission. The registry design and variables for inclusion in the registry were defined with input from clinicians, institutional leadership, and data analysts. For implementation, specific clinical workflows were established and responsible team roles were designated.

Primary Presenter: **Peter Yarger**

Project Title: *Blockade of Osteoclast-Mediated Bone Resorption with a RANKL Inhibitor Enhances Spinal Fusion in a Rat Model*

Primary Mentor: Karin Payne

Thematic Area: Basic Biomedical Science

Abstract:

#### ABSTRACT

**Background:** Bone allograft is often used during spinal fusion to provide a scaffold for bone remodeling, with osteoclasts and osteoblasts working to incorporate allograft into the spine. The former resorbs existing bone, then the latter secretes new matrix. Osteoprotegerin (OPG) is a soluble RANKL inhibitor that blocks osteoclast differentiation and activation. Inhibiting osteoclast-mediated bone resorption may allow for more matrix deposition, thereby promoting improved spinal fusion. OPG does not incorporate into bone matrix and has a quick and reversible effect, thus making it a potential candidate to control the remodeling process and enhance bone formation. This study aimed to determine whether administration of an antiresorptive agent such as OPG will increase the amount of bone formed in a rat model of spinal fusion, and whether a timing-dependent dosing regimen of OPG would allow for a more targeted control.

**Methods:** Forty-eight male Sprague-Dawley rats received a one-level posterolateral intertransverse fusion with bone allograft. Rats were divided into 4 groups according to initiation of OPG or saline administration: (1) saline at Day 0, (2) OPG initiated at Day 0, (3) OPG initiated at Day 10, or (4) OPG initiated at Day 21 post-surgery. Rats received weekly subcutaneous injections of rat OPG-Fc (10 mg/kg) and were euthanized at 6 weeks post-surgery. Quantitative microCT (µCT) analysis of the fusion was performed, as well as histology to determine the percentage of the trabecular bone surface lined with osteoclasts. Statistics were performed using a one-way ANOVA.

**Results:** MicroCT analysis of the total fusion site and around the spinous process revealed a greater bone volume fraction in the groups that received OPG injections starting at day 0 and day 10 after surgery when compared to the group receiving saline. Mean trabecular thickness was significantly increased in the groups receiving OPG at day 0, 10 and 21, with rats receiving OPG at day 0 and 10 after surgery having significantly greater mean trabecular thickness than those receiving OPG at day 21 post-op. Quantitative histological analysis revealed a smaller percentage of trabecular bone surface lined with osteoclasts in all groups that received OPG injections, especially in the OPG D0 and D21 groups.

**Conclusion:** This study demonstrated that administration of OPG after spinal fusion has a dramatic impact on bone metabolism. OPG administration resulted in increased bone volume and trabecular thickness, with the greatest response seen when initiated on the surgical day or at post-surgical day 10. This demonstrates the time critical nature of OPG administration initiation. Decreased number of osteoclasts on histology when coupled with the increased bone volume and trabecular thickness suggest success of OPG in inhibiting osteoclast bone resorption and allowing additional bone formation to promote a more mature spinal fusion when initiated either on the day of surgery or at post-surgical day 10.

Clinical Relevance: The results of this pre-clinical study show that OPG could potentially have a dramatic impact on bone healing and bone fusion, not only in spine fusion surgery, but also in the general area of bone healing from fractures or around implants. With increased levels of bone in treated patients, OPG could accelerate healing, improve healing in osteoporotic patients, and decrease the risk of non-union; thus dramatically improving post-surgical and post-fracture clinical outcomes.

Primary Presenter: **Jingjing Yu**

Project Title: *Overexpression of TGF- $\beta$ 2 in Smad4 deficient head and neck squamous cell carcinomas promotes myeloid cell infiltration associated with metastatic progression*

Primary Mentor: Xiao-Jing Wang

Thematic Area: Basic Biomedical Science

Abstract:

**Purpose of Study:** Transforming growth factor- $\beta$ 2 (TGF- $\beta$ 2) has been shown to promote tumor progression when overexpressed and could be an important biomarker for head and neck squamous cell carcinoma (HNSCC) prognosis and treatment. Overexpression of TGF- $\beta$ 2 in tumor epithelia and stroma is observed in Smad4-/- HNSCCs and is known to upregulate inflammation and angiogenesis, potentially providing a tumor promoting microenvironment. We aimed to determine if TGF- $\beta$ 2 overexpression mediates tumor progression of Smad4-/- SCCs and elucidate the mechanisms involved. We hypothesized that Smad4-/- SCCs overexpress TGF- $\beta$ 2 to support an inflammatory microenvironment, induce EMT signaling and promote angiogenesis to drive tumor growth and metastasis in vivo.

**Methods:** Athymic mice were injected subcutaneously in the flank with SCC cells derived from keratinocyte-specific Smad4 knockout mice and treated with either a TGF- $\beta$ 2R inhibitor or a vehicle control once primary tumors reached 1mm<sup>3</sup>. Using immunofluorescence (IF) or immunohistochemistry (IHC), sections of the primary tumor were probed with markers of leukocytes, myeloid cells, macrophages, EMT, and angiogenesis.

**Results:** Inhibition of the TGF- $\beta$ 2R in Smad4-/- SCCs did not affect tumor growth in immune compromised mice but significantly decreased the number of metastatic lesions compared to the vehicle control. There was also a significant decrease in CD45+ leukocytes, with a specific decrease in CD11b+Ly6G+ cells in TGF- $\beta$ 2R inhibitor treated tumors compared to vehicle treated tumors. E-cadherin expression was unchanged between the two groups but TGF- $\beta$ 2R inhibitor treated tumors had decreased expression of mesenchymal markers N-cadherin and  $\alpha$ -SMA. However, there was no significant difference in angiogenesis as measured by the number of blood vessels/mm<sup>2</sup> and the percentage area of the tumor covered by blood vessels.

**Conclusion:** Inhibition of TGF- $\beta$ 2R correlates with decreased metastasis of Smad4-/- SCCs and decreased myeloid cells infiltration, suggesting TGF- $\beta$ 2 overexpression in Smad4-/- SCCs mediates tumor progression partly by increasing inflammation in the tumor stromal environment. Metastasis may be occurring independent of EMT but other processes could be involved to support a mesenchymal cell phenotype. Overexpression of TGF- $\beta$ 2 also contributes to angiogenesis in Smad4-/- SCCs but inhibiting the TGF- $\beta$ 2R alone may not be sufficient to reduce angiogenesis.

Primary Presenter: **Leonid Zukin**

Project Title: *Aldose Reductase Inhibition Prevents Fibrotic Changes Following Cataract Surgery and Promotes Ocular Lens Regeneration*

Primary Mentor: Mark Petrash

Thematic Area: Basic Biomedical Science

Abstract:

**Purpose:** Cataract surgery is a procedure by which the lens fiber cell mass is removed from its capsular bag and replaced with a synthetic intraocular lens. Postoperatively, remnant lens epithelial cells can undergo an aberrant wound healing response characterized by an epithelial-to-mesenchymal transition (EMT), leading to posterior capsular opacification (PCO). Aldose reductase (AR) inhibition has been shown to decrease EMT markers in cell culture models. In this study, we aim to explore the effects of AR inhibition on the postoperative intraocular response using an in vivo model of cataract surgery.

**Methods:** A modified extracapsular lens extraction (ECLE) was performed on C57BL/6 wildtype, AR overexpression (AR-Tg), and AR knockout mice. Immunofluorescent staining for the myofibroblast marker  $\alpha$ -smooth muscle actin ( $\alpha$ -SMA), epithelial marker E-cadherin, and lens fiber cell marker  $\alpha$ -crystallin was used to characterize postoperative PCO. Quantitative reverse transcription PCR (qRT-PCR) was employed to quantify postoperative changes in  $\alpha$ -SMA, vimentin, fibronectin, and E-cadherin. In a separate experiment, the AR inhibitor Sorbinil was applied postoperatively and qRT-PCR was used to assess changes in EMT markers. Long-term postoperative changes were analyzed by histology using hematoxylin and eosin staining.

**Results:** Genetic AR knockout reduced ECLE-induced upregulation of  $\alpha$ -SMA and downregulation of E-cadherin. These immunofluorescent changes were mirrored quantitatively in changes in mRNA levels. Similarly, Sorbinil reversed characteristic postoperative EMT changes in AR-Tg mice. Interestingly, genetic AR knockout did not prevent postoperative induction of the lens fiber cell marker  $\alpha$ -crystallin. Genetic AR knockout mice displayed appreciable regeneration of lens material 1-2 months postoperatively, compared to minimal regeneration in AR-Tg and wildtype mice.

**Conclusions:** AR inhibition prevents the postoperative changes in EMT markers characteristic of PCO yet preserves the postoperative induction of lens fiber cell markers. Furthermore, AR inhibition may augment lens regeneration.