



SCHOOL OF  
**MEDICINE &  
DENTISTRY**  
UNIVERSITY *of* ROCHESTER  
MEDICAL CENTER

***Medicine of the Highest Order***

2016

# Annual Medical Student Abstract Journal

*Sponsored by:*

Center for Advocacy, Community Health, Education and Diversity

Offices for Medical Education

Medical Student Research Faculty Advisory Committee

Community Outreach Faculty Advisory Committee

International Medicine Faculty Advisory Committee

Medical Humanities Faculty Advisory Committee

**Brian Ayers**

Preceptors:

Connor Beshaw

University of Rochester Medical Center

Cardiology Department

Ernesto Serrano-Finetti, Oscar Casas, Ramon Pallas-Areny, and Jean-Philippe Coudrec

Universitat Politècnica de Catalunya,

BarcelonaTech

**ENABLING ATRIAL FIBRILLATION DETECTION USING A WEIGHT SCALE**

**Aims:** In this proof-of-concept study we evaluate the ability of a weight scale with embedded limb-lead ECG recording capability to detect the presence of atrial fibrillation (AF) in a clinical setting.

**Methods:** ECGs were recorded using the prototype of a weight scale embedded with hand and feet sensors to acquire body-surface ECGs. We evaluated this prototype for AF detection in cardiac patients going through an inpatient clinic (University of Rochester Medical Center, Rochester, NY). Two trained ECG experts annotated the ECGs as either AF or normal sinus rhythm. The ECGs were randomly separated into two datasets: learning and validation. We modified the RdR map method for AF detection using the ECGs recorded with the scale device. This method plots RR intervals versus change in RR intervals to distinguish irregularly irregular heartbeats. The learning set was used to adjust the method parameters (cell size and classification threshold) to maximize classification accuracy. In addition, we investigated the relationship between the length of the ECG and accuracy of AF detection.

**Results:** We enrolled 60 patients ( $62 \pm 12$  yrs, 68% male) and recorded 153 ECGs using the scale device; 25 ECGs were in AF, the remaining in sinus rhythm. After optimizing the algorithm on the learning set (N=77 ECGs), the AF detection method delivered 83% accuracy (sensitivity and specificity = 83%, N = 76) using the validation dataset. Applying a constraint that each ECG recording contains a minimum of 7 beats in order to be eligible for classification, accuracy improved to 89% (sensitivity = 83%, specificity = 90%, N = 70).

**Conclusion:** We present an innovative device for AF detection that can be seamlessly integrated into physicians' current workflow without any significant changes to current medical routines.

**Acknowledgements:** This research was supported by the Offices for Medical Education at the University of Rochester Medical Center.

## Basic Science, Clinical & Translational Research

### **David N. Bernstein**

Preceptors

Addisu Mesfin, MD

University of Rochester School of Medicine and Dentistry

Department of Orthopaedic Surgery

Department of Neurosurgery

Kevin J. Bozic, MD, MBA

Dell Medical School at The University of Texas at Austin

Department of Surgery and Perioperative Care

### **CHALLENGES IN ASSESSING VALUE IN ORTHOPEDIC SURGERY**

#### ***Background***

As consumerism in medicine continues to increase, the Internet is one tool commonly used by patients to seek out healthcare information, including for orthopedics.

Understanding the most commonly found information about cost, quality and patient experience through online searches is important to improving patient experience and care.

#### ***Questions/Purposes***

We asked three questions: 1) What is the availability ("findability") of cost, quality and patient experience information related to orthopedic services both with and without a geographic identifier; 2) How does the information available on each website compare to the other websites commonly found by patients? 3) How do the search results compare between searches done with and without a geographic identifier?

#### ***Methods***

A list of 21 common search terms was compiled a priori. Using Google, each term was searched with and without a geographic identifier. The top 15 results were recorded. Findability, source of information, website ownership, information available (cost, quality and/or patient experience) and frequency of website updates were noted. Bivariate analysis was used to compare results.

#### ***Results***

Our general and location-specific searches led to nine and 17 unique websites with at least five hits, respectively. Two and five websites were "high findability" using general and location-specific search terms, respectively. The prevalence of provider websites was significantly higher using the geographic identifier (47% vs. 0%,  $p = 0.023$ ). There was a significantly higher prevalence of patient experience information when using the

location-specific search terms (59% vs. 11%, 0.036). However, there was no difference in the prevalence of sites offering cost (0% vs. 0%,  $p = 0.99$ ) or quality (59% vs. 33%,  $p = 0.41$ ) between the two groups. No website in either search provided cost information. Ownership did not differ between the two search groups: government (0% vs. 11%,  $p = 0.35$ ); non-profit (41% vs. 11%,  $p = 0.19$ ); and for-profit (59% vs. 78%,  $p = 0.42$ ).

### ***Conclusions***

The Internet can be a rich source of quality and patient experience information for orthopedic patients. However, the use of search engine optimization and other marketing techniques may limit the ability of patients to receive unbiased and complete information.

### ***Acknowledgement Statement***

We would like to acknowledge the generous summer living stipend support for research provided by the University of Rochester School of Medicine & Dentistry Office of Medical Education (OME) and Center for Advocacy, Community Health, Education and Diversity (CACHED).

## Basic Science, Clinical & Translational Research

### **Mariah Blegen**

Preceptors

Emily Nebzydoski, MD

Katherine B. Greenberg, MD

Andrew Aligne, MD, MPH

Department of Pediatrics, School of Medicine and Dentistry, University of Rochester Medical Center

### **OVERCOMING MISSED OPPORTUNITIES FOR TEEN PREGNANCY PREVENTION: CONTRACEPTIVE IMPLANT TRAINING FOR PEDIATRIC RESIDENTS**

**Background:** The US has the highest teen pregnancy rate of any wealthy nation. Adolescent mothers have an increased risk for low birth weight or premature babies and are more likely to drop out of school and face limited economic opportunities. Thus, teen pregnancy prevention is a public health priority. Much progress has been made at reducing teen pregnancy rates, leading the CDC to declare it a “Winnable Battle.” One strategy to win is increasing access to long-acting reversible contraception (LARC). LARC methods (intrauterine devices and the contraceptive implant) are safe, highly-effective, and are recommended as first-line contraceptives for teens by the American Academy of Pediatrics and other official organizations. Yet nationwide, only 7% of sexually active teens use LARC. One known barrier is the lack of LARC-trained primary care physicians. We hypothesized that pediatric residents would accept LARC training and that it would improve their comfort level with counseling teens about contraception.

**Objective:** To implement a curricular change intervention to train all pediatric residents in contraceptive implant insertion.

**Design/Methods:** Our program was designed and evaluated using the CDC’s Promoting Science-Based Approaches-Getting To Outcomes (GTO) framework. We applied the ten steps of GTO as follows:

- (1) *Focus:* There are several types of LARC available; we focused on the contraceptive implant, which is the simplest to insert.
- (2) *Target:* We chose pediatric residents as the target of our intervention.
- (3) *Adopt*, (4) *Adapt:* We adopted an existing 2-hour contraceptive implant insertion training and adapted the logistics to fit into the residency curriculum.
- (5) *Resources:* We partnered with a local LARC initiative and other available resources.

- (6) *Plan*: To plan the intervention we engaged chief residents, attendings, and administrators.
- (7) *Monitor*: We gathered feedback from stakeholders and surveyed residents to monitor their comfort with contraception counseling, and opinion on LARC training, and its availability without a referral.
- (8) *Evaluate*: We evaluated successful implementation of the project by measuring the percent of residents who received the training.
- (9) *Improve*, (10) *Sustain*: To improve and sustain the program, we established continuing roles for the residency program coordinator and moved the training to pediatric intern orientation.

**Results:** The first two years of the program increased the percentage of residents trained from 0 to 93. Prior to the training, 22 out of 26 pediatric residents reported wanting implant insertion training during residency and 25 out of 26 residents said pediatric residencies should offer training. Following the training, 100% stated that implants should be offered in their primary care clinics without referral and 13 out of 14 felt that the implant training improved their adolescent contraceptive counseling.

**Conclusions:** Adding contraceptive implant training to the residency curriculum was a system change intervention that ensured all pediatrics residents will be trained. The intervention increased physician comfort in adolescent contraception counseling. As a result, more patients will be getting accurate information about the safety, effectiveness, and availability of LARC. Also, more residents now want to insert implants in their own practices, thus increasing LARC accessibility for our teen patients. This intervention is one part of the multifaceted approach to reducing teen pregnancy in Rochester. Replicating this program in other pediatrics residencies could extend its impact nationally and enhance progress on this public health priority.

**Acknowledgements:** We gratefully acknowledge support from the Greater Rochester Health Foundation for the LARC Initiative. This project was inspired and assisted by the LARC Initiative.

**Timothy Campbell**

Preceptors

Jonathan Stone

Edward Vates

Amrendra Miranpuri

University of Rochester School of Medicine and Dentistry

Department of Neurosurgery

**CEREBRAL MECHANICAL THROMBECTOMY SIMULATOR USING HYDROGEL POLYMERS AND 3D PRINTING TECHNOLOGY**

**Introduction.** While stroke remains a leading cause of death and disability, recent advances in endovascular technology have a real potential to make a significant impact in clinical outcomes. Unfortunately, training opportunities are sparse, preventing dissemination of these techniques. Hands-on training is further stunted by the critical time to therapy associated with stroke treatment. We therefore created a physical model for stroke simulation that allows residents and fellows to practice mechanical thrombectomy.

**Methods.** A simplified virtual model of the anterior cerebral circulation was created based on an amalgamation of patient imaging. This luminal model was 3D printed using flexible filament and attached to a guide catheter at the proximal carotid to provide endovascular access and an IV tube at the distal M2 branches to permit outflow. A 7Fr sheath was also connected at anterior cerebral artery to permit placement of a realistic clot and create a simulation of a proximal M1 occlusion. This entire construct was placed into a container of polyvinyl alcohol (PVA) and after crosslinking the flexible print was removed.

**Results.** Using 3D printing technology and polymer hydrogels, a low-cost high fidelity stroke model was achieved. Despite its simplified anatomy, the model permitted realistic wire and catheter navigation through the different segments of the internal carotid and middle cerebral arteries. The ACOM sheath provided a convenient method to reliably place an embolism and created a life-like proximal M1 occlusion. Recanalization was performed using the solumbra technique, retrieving clot similar to human experience.

**Conclusions.** We demonstrated proof of concept for a mechanical thrombectomy simulation. The angiographic profile and response to endovascular tools created a



training experience similar to live endovascular procedures. As the model is perfected visually and mechanically, our next steps are to perform validation studies and create a training curriculum.

**Acknowledgements.** The author would like to acknowledge the Office of Medical Education at the University of Rochester School of Medicine and Dentistry for funding support.

## Basic Science, Clinical & Translational Research

### **Bonnie Cao**

Preceptors

Faith C. Njoku

Massachusetts General Hospital

Department of Surgery

University of California, Irvine, School of Medicine

Yanik J. Bababekov

Anne Marie King

Barb Luby

David C. Chang

Heidi Yeh

Massachusetts General Hospital

Department of Surgery

### **DO OBJECTIVE ASSESSMENTS MATCH ADOLESCENT TRANSPLANT PATIENTS' PERCEPTIONS OF TRANSITION READINESS?**

#### **Introduction**

The period of transition from pediatric to adult care in organ transplant patients is associated with increased risk of graft loss, which may be attributed to poor compliance secondary to knowledge gaps.<sup>1,2</sup> Previous work has largely utilized subjective questionnaire tools to assess patient readiness to transition to the adult health care system.<sup>3</sup> We observed anecdotally that patient perception of readiness did not always correspond to caregiver perception, so we developed a novel objective questionnaire to assess the accuracy of these perceptions.

#### **Methods**

Pediatric kidney and liver transplant patients  $\geq 15$  years old completed paired subjective and objective transition readiness questionnaires measuring health knowledge, self-management skills, and psychosocial adjustment. Patients completed the surveys while being seen in the transplant clinic or over the telephone. Each paired survey question was considered in "agreement" if the patient's answers to both the subjective and objective forms of the question matched; "overconfident" if the patient answered the subjective form of the question claiming full knowledge but was unable to answer the

objective form of the question accurately; and "underconfident" if the patient answered the subjective form of the question doubting their knowledge but was able to answer the objective form of the question accurately. Non-parametric tests and regression analysis were used to determine differences in survey responses based on age, gender, time since transplant, and type of organ transplant.

## **Results**

Of the 47 patients identified as age  $\geq 15$  years old, 21 completed the survey (44.7%). The patients ranged from age 15 to 25 years old. The median percent of paired questions scored as "agreement," "overconfident," and "underconfident" were 68.2% (IQR = 66.7%-77.3%), 18.2% (IQR = 9.1%-27.3%), and 9.5% (IQR = 4.5%-13.6%). Age  $> 18$  years old at the time of questionnaire completion and liver transplantation (vs. kidney transplantation) were associated with slightly higher rates of overconfidence, but these differences were not statistically significant. Male gender and greater time since transplant were associated with slightly lower rates of overconfidence, but again, these were not statistically significant.

## **Conclusions**

Accurately assessing transition readiness among pediatric transplant patients is vital in educating and supporting patients as they prepare to transition to independent care. We found that patients' perception of their skills agreed with their demonstrated skills less than 70% of the time. This disconnect suggests that not all adolescent and young adult patients may be ready to make informed decisions regarding their care. Moreover, assessment tools depending only on subjective questionnaires may not adequately guide patient education or accurately determine readiness for transition and transfer.

## **References**

1. Watson AR. Non-compliance and transfer from paediatric to adult transplant unit. *Pediatr Nephrol*. 2000 Jun;14(6):469-472.
2. Samuel SM, Nettel-Aguirre A, Hemmelgarn BR et al. Graft failure and adaptation period to adult healthcare centers in pediatric renal transplant patients. *Transplantation*. 2011 Jun;91(12):1380-1385.
3. Fredericks EM, Dore-Stites D, Well A et al. Assessment of transition readiness skills and adherence in pediatric liver transplant recipients. *Pediatr Transplant*. 2010 Dec;14(8):944-953.

**Isabelle Chu**

Preceptors

Chris Gange, MD

Timothy M. Baran, PhD

Susan K. Hobbs, MD, PhD

URMC

Department of Imaging Sciences

**ESTABLISHING A REFERENCE DISTANCE FOR INTERPRETING ESOPHAGEAL LESIONS ON PET/CT**

Thoracic imaging is an important tool for the management of multiple esophageal lesions. In addition, use of positron emission tomography (PET) and thoracic computed tomography (CT) in conjunction with endoscopic ultrasound is encouraged for the determination of esophageal cancer staging following endoscopic diagnosis, measuring mass size and infiltration as well as the extent of metastases (1, 3).

Radiographic imaging is also useful in evaluating preoperative treatment of esophageal carcinomas, since lymph node involvement is a strong predictor of post-operative survival (2). Given that many later stage esophageal cancers may relapse in the first 24 months after chemoradiotherapy, imaging studies are recommended for regular surveillance as well (4). Thus, referrals from gastroenterology or thoracic surgery often necessitate the use of PET/CT.

Most measurements made indicating the site of the tumor on endoscopic exam use the incisors as a frame of reference. Using teeth as a landmark can make it difficult to maintain continuity in measurements between departments, as chest CTs do not include the head. The esophagus is located in a region with many anatomical landmarks nearby, including the carina and aortic arch. By establishing a new landmark, something reported to be a certain distance from the incisors could be translated into a distance measurable on standard CT studies. This landmark will allow radiologists to provide reports that are consistent with the information provided in the referral. It may also help to prevent erroneous confirmation of tumor removal after preoperative treatment. No such measurement guideline ensuring continuity between endoscopy and radiographic imaging has previously been established. This new referral measurement may have additional utility in the diagnosis of hard-to-see strictures or other benign esophageal lesions for which thoracic radiologists receive a referral.

Retrospectively reviewing the last five years, the electronic radiology information system (RIS) was used to identify subjects with esophageal lesions or tumors as

evidenced by PET/CT. Electronic records were also checked for previous esophagogastroduodenoscopy (EGD) and diagnostic CT. Subjects were excluded if there was no record of an EGD with a measurement from the incisors to the lesion, if they had a previous esophagectomy, were lacking a definable mass, or had a hiatal hernia. A total of 120 patient records (84 male, 36 female) were used in this study.

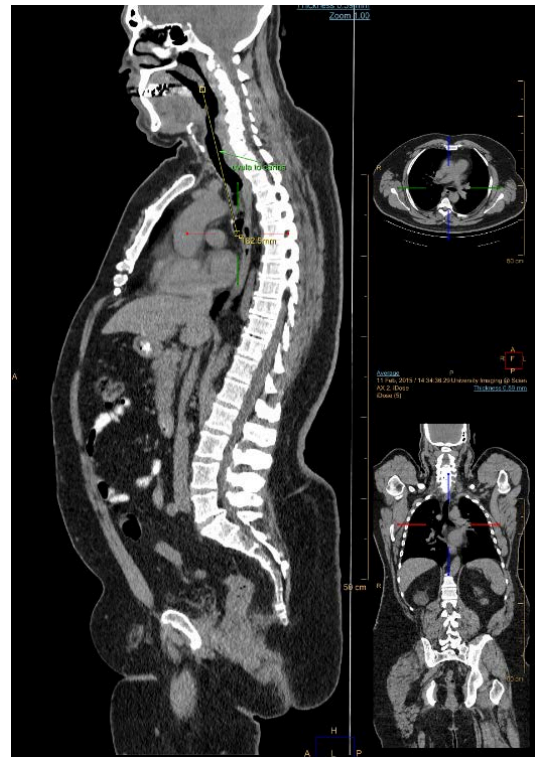
The distance from the incisors reported in each EGD report was recorded. Using the PACS Intellispace system, measurements were recorded on each patient's PET/CT study done most proximally to the date of the EGD. Since patients may be slightly rotated in the CT scanner, images were manipulated so that the incisors and uvula were in the same place sagittally, as well as the uvula and carina. The linear tool was used to draw a straight line and obtain a measurement from incisor to uvula, then from uvula to carina. These two measurements were summed and recorded. This value was then compared to the lesion location reported in the EGD to obtain a regression that could be used to estimate the lesion location using CT.

Once a regression was obtained, this regression was used to estimate how far above or below the carina the esophageal lesion would be on PET/CT. This measurement was translated to slices using the reported slice width on the patient's CT scan. The diagnostic CT was used to confirm whether the estimated lesion location corresponded to the location on EGD.

For all data combined, estimated lesion location (based on each patient's measurements) was significantly different from the EGD lesion location ( $p=0.009$ ), but there was a strong correlation between the estimate and the actual location ( $r=0.77$ ). Gender was the most strongly associated with lesion location, with height and age as other possible confounders.

When patients were separated based on gender, estimated lesion location was similar to actual location for females using the averaging technique ( $p=0.79$ ) and each patient's measurement ( $p=0.91$ ). For males, there were significant differences for both averaging ( $p=0.018$ ) and individual measurements ( $p=0.016$ ).

Based on our results, the use of an anatomic landmark such as the carina may be useful in identifying lesions on imaging for female patients with an esophageal lesion. However, further investigation using a larger sample size and different methods of



approximating EGD scoping are required to see if this is useful for the general population.

## References

1. Walker AJ, Spier BJ, Perlman SB, Stangl JR, Frick TJ, Gopal DV, Lindstrom MJ, Weigel TL, Pfau PR. Integrated PET/CT fusion imaging and endoscopic ultrasound in the pre-operative staging and evaluation of esophageal cancer. *Mol Imaging Biol*. 2011 Feb;13(1):166-71. doi: 10.1007/s11307-010-0306-0. PubMed PMID: 20379789.
2. Duong CP, Hicks RJ, Weih L, Drummond E, Leong T, Michael M, Thomas RJ. FDG-PET status following chemoradiotherapy provides high management impact and powerful prognostic stratification in oesophageal cancer. *Eur J Nucl Med Mol Imaging*. 2006 Jul;33(7):770-8. Epub 2006 Mar 21. PubMed PMID: 16550384.
3. Choi J, Kim SG, Kim JS, Jung HC, Song IS. Comparison of endoscopic ultrasonography (EUS), positron emission tomography (PET), and computed tomography (CT) in the preoperative locoregional staging of resectable esophageal cancer. *Surg Endosc*. 2010 Jun;24(6):1380-6. doi: 10.1007/s00464-009-0783-x. Epub 2009 Dec 24. PubMed PMID: 20033712.
4. Sudo K, Xiao L, Wadhwa R, et al. Importance of Surveillance and success of salvage strategies after definitive chemoradiation in patients with esophageal cancer. *J Clin Oncol* 2014; 32:3400-3405

## Acknowledgements

Thank you to the Office of Medical Education for their generous funding of this project.

## Basic Science, Clinical & Translational Research

### **Armond Collins**

Preceptors

Michele Saul, PhD

Emily Kelly, PhD

University of Rochester Medical Center

Department of Neuroscience

Julie Fudge, MD

University of Rochester Medical Center

Department of Neuroscience

Department of Psychiatry

### **MYELINATION IN THE ADULT MALE RAT AMYGDALA FOLLOWING REPEATED VARIABLE STRESS IN ADOLESCENCE**

Acknowledgement Statement: I would like to thank the Babigian Summer Research Fellowship in Psychiatry for funding this project.

Adolescence is a time of rapid maturation and change across species, both physically and behaviorally. During adolescence, organisms become more independent, relying on their own experiences to learn about the world and exploring new social groups and territories. In addition, changes in overall body size, sexual maturation and continued brain growth occur. This brain growth involves changes in neural and glial organization in all areas of the brain, including the amygdala, a structure in the temporal lobe that mediates emotion and social behaviors. Due to all of these changes, adolescence is often considered a sensitive period of development during which perturbations such as stress can disrupt normal development. Stress during adolescence in humans is a risk factor for the development of psychopathology involving the amygdala, including schizophrenia, mood disorders, psychosis, and substance abuse.

Previous work by Saul, et al. has shown that during adolescence, the amygdala of rats contains a population of proliferating bromodeoxyuridine (BrdU; a marker of DNA replication) positive cells 4-5x larger than the population in adults (Saul et al., 2013). Further characterization with neural markers showed that approximately 50% of BrdU-positive cells co-localize with neural-glial antigen (NG2), which identifies a unique type

of oligodendrocyte precursor. Stress during adolescence significantly reduces these NG2/BrdU double-labeled cells. This suggests that myelin producing precursors (oligodendrocyte precursors, OPCs) are decreased by adolescent stress in the rat amygdala. This may indicate that adolescent stress results in either precocious maturation of OPCs leading to more myelin or decreased OPCs leading to reduced myelin.

Isolation stress immediately after weaning in mice has shown lasting changes in myelin development and behavior. Mice that were isolated showed decreased sociability and working memory skills by postnatal day (PND) 50 which correlated with hypomyelination. Abnormal myelination can cause abnormal information processing, which may contribute to the poor social and working-memory skills in these mice (Makinodan et al., 2012). Weaning stress may also lead to precocious myelination in the mouse amygdala (Ono et al., 2008), indicating that the effects of stress may be brain-region and/or timing-specific.

The current research focuses on determining how a short bout of unpredictable stress in early adolescence may alter myelin density in the amygdala in early adulthood. To determine whether stress in early adolescence influences myelination of the amygdala, male Sprague-Dawley rats were exposed to a repeated variable stress (RVS) paradigm. The 3-day RVS consists of alternating exposure to three physical stressors: an elevated platform, inescapable foot shock, and forced swim. Rats were sacrificed via perfusion at PND 72 (young adulthood), brains were removed and cut into 40 micrometer sections.

A Black Gold II staining protocol was used to impregnate myelin and label white matter in every 12th section through the amygdala of the rats. Once stained, two areas from each amygdala, the basolateral nucleus (BLA) and the posterior lateral cortical nucleus (PLCo), and a control region (S1; primary sensory cortex) were visualized from both hemispheres under a light microscope and photographed. Using the ImageJ2 program, the myelin density was calculated for all brain areas in all sections.

There was significantly more myelin in the control region (S1) compared to the BLA in both control ( $p < 0.05$ ) and experimental groups ( $p < 0.01$ ). The BLA and PLCo regions were not significantly different from each other. Differences between control and stress group myelin densities in the S1, BLA, or PLCo regions were not significant ( $p = 0.054$ ), but did show a trend towards decreased myelination in the stress group compared to the control group. It is possible that the difference did not reach significance due to small cohort size ( $n = 23$ ) and relatively low power. This project will



continue by increasing the number of animals analyzed. If significant differences are seen, electron microscopy will be used to determine if there are changes in microscopic amygdala structure.

#### References:

- Benes, F. M. (1989). Myelination of cortical-hippocampal relays during late adolescence. *Schizophrenia Bulletin*, 15(4), 585-593.
- Benes, F. M., Turtle, M., Khan, Y., & Farol, P. (1994). Myelination of a key relay zone in the hippocampal formation occurs in the human brain during childhood, adolescence, and adulthood. *Archives of General Psychiatry*, 51(6), 477-484.
- Makinodan, M., Rosen, K. M., Ito, S., & Corfas, G. (2012). A critical period for social experience-dependent oligodendrocyte maturation and myelination. *Science (New York, N.Y.)*, 337(6100), 1357-1360. doi:10.1126/science.1220845 [doi]
- Ono, M., Kikusui, T., Sasaki, N., Ichikawa, M., Mori, Y., & Murakami-Murofushi, K. (2008). Early weaning induces anxiety and precocious myelination in the anterior part of the basolateral amygdala of male Balb/c mice. *Neuroscience*, 156(4), 1103-1110. doi:10.1016/j.neuroscience.2008.07.078 [doi]
- Saul, M. L., Helmreich, D. L., Callahan, L. M., & Fudge, J. L. (2014). Differences in amygdala cell proliferation between adolescent and young adult rats. *Developmental Psychobiology*, 56(3), 517-528. doi:10.1002/dev.21115 [doi]
- Saul, M. L., Helmreich, D. L., Rehman, S., & Fudge, J. L. (2015). Proliferating cells in the adolescent rat amygdala: Characterization and response to stress. *Neuroscience*, 311, 105-117. doi:10.1016/j.neuroscience.2015.10.003 [doi]
- Saul, M. L., Tylee, D., Becoats, K. T., Guerrero, B. G., Sweeney, P., Helmreich, D. L., & Fudge, J. L. (2012). Long-term behavioral consequences of stress exposure in adolescent versus young adult rats. *Behavioural Brain Research*, 229(1), 226-234. doi:10.1016/j.bbr.2012.01.022 [doi]
- Schmued, L., Bowyer, J., Cozart, M., Heard, D., Binienda, Z., & Paule, M. (2008). Introducing black-gold II, a highly soluble gold phosphate complex with several unique advantages for the histochemical localization of myelin. *Brain Research*, 1229, 210-217. doi:10.1016/j.brainres.2008.06.129 [doi]
- Spear, L. P. (2013). Adolescent neurodevelopment. *The Journal of Adolescent Health : Official Publication of the Society for Adolescent Medicine*, 52(2 Suppl 2), S7-13. doi:10.1016/j.jadohealth.2012.05.006 [doi]
- Spear, L. P. (2013). Adolescent neurodevelopment. *The Journal of Adolescent Health : Official Publication of the Society for Adolescent Medicine*, 52(2 Suppl 2), S7-13. doi:10.1016/j.jadohealth.2012.05.006 [doi]
- Vargas, W. M., Bengston, L., Gilpin, N. W., Whitcomb, B. W., & Richardson, H. N. (2014). Alcohol binge drinking during adolescence or dependence during adulthood reduces prefrontal myelin in male rats. *The Journal of Neuroscience : The Official Journal of the Society for Neuroscience*, 34(44), 14777-14782. doi:10.1523/JNEUROSCI.3189-13.2014 [doi]

## Basic Science, Clinical & Translational Research

**Connor Craig**

Preceptors

Mohammad Fidahusain, M.B.B.S.

Scott McIntosh, Ph.D.

University of Rochester

Department of Public Health Sciences

### **TRANSPORTATION AS A DETERMINANT OF HEALTHCARE ACCESSIBILITY IN ROCHESTER, NY**

#### Background

Access to healthcare can be defined by the following dimensions: availability, accessibility, accommodation, affordability, and acceptability. Commonly used indicators such as cost and insurance coverage take into account socioeconomic barriers to care, yet the physical ability to access care may be under-studied. Transportation disadvantages in an urban, automobile-oriented setting such as the City of Rochester may serve as a significant barrier to care for residents wishing to access both preventive and maintenance care, resulting in poor healthcare outcomes.

#### Methods

This was a cross-sectional study which evaluated the degree to which transportation acts as a barrier to healthcare in the Rochester community and measured the effects of said barrier on healthcare outcomes. A survey was designed to gather data on respondent demographics, modes of transportation, effects on access, and general healthcare outcomes. Surveys were administered to patients presenting to three UR Well clinics located within the City of Rochester from June 6 to August 8, 2016. In total 69 surveys were completed, 65 were used in the final analysis.

#### Results

Respondents were divided into two groups: those reporting no issues traveling to medical appointments (non-transportation disadvantaged; non-TD) and those reporting one or more issues (transportation disadvantaged; TD). Of the surveys analyzed, 31% of respondents reported having an issue traveling to medical appointments. Of those respondents 70% reported that transportation issues affected their ability to get medical care "sometimes", "most of the time", or "always". Seventy-nine percent of respondents in the TD group were women, 60% were under the age 35, and 65% were African

American. A greater portion (45%) of the TD group reported earning less than \$10,000 than did those who were non-TD (16%) ( $p < 0.003$ ). The most common issues for accessing medical appointments were: not owning an automobile (75%), having no one to depend on (50%), not wanting to ask or inconvenience other (40%), cost (35%), and limited public transportation (35%). Patients in the TD group reported missing more medical appointments in the last 12 months than those in the non-TD group ( $p < .005$ ). There were no differences between the TD and non-TD groups with regards to self-reported chronic medical conditions, nor to self-reported emergency department visits, hospitalizations, or ambulance rides in the previous 12 months.

### Conclusions

A large proportion of patients report that issues with transportation affect their ability to access medical care. A majority of these respondents were African American women under the age of 35, with many earning less than \$10,000 per year. Not having an automobile was the most commonly cited reason for decreased access, however lack of public transportation and social supports were notable complaints as well. Most importantly, a lack of transportation was associated with the number of missed medical appointments. This study was limited by its cross-sectional nature and small sample size. Further investigations should aim to elucidate the relationship between missed medical appointments and healthcare outcomes on a longitudinal basis.

## **Taylor D'Amore**

Preceptors

Dr. Miho Tanaka

Dr. Andrew Cosgarea

The Johns Hopkins University

Department of Orthopaedic Surgery

### **CLASSIFYING THE J-SIGN TO PREDICT PATELLAR INSTABILITY**

#### Introduction:

Patellar maltracking is a sign of potential patellar instability. The J-sign, for example, is determined by observing the movement of the patella from its position in knee flexion to its most lateral position when the knee is fully extended. Dynamic kinematic computed tomography (DKCT) is a tool that allows dynamic assessment of the patellofemoral joint. Tanaka et al. recently proposed a new classification system to quantify patellar maltracking patterns using DKCT and found 93% sensitivity for detecting symptoms of patellar instability in Grade 3 J sign. The aim of this study was to apply this classification system and describe its application in a cohort of patients with patellar instability.

#### Methods:

16 patients with symptomatic patellar instability underwent DKCT during their preoperative workup and both knees from each patient were used in the study. Using dynamic images, the patellar bisect offset was measured in 10° intervals of knee flexion during active movement. Patellar maltracking was graded based on the described classification, using J-sign grades of J1, J2, and J3 respectively. The severity of maltracking was correlated with patellar instability symptoms and described in terms of patient age and gender.

#### Results:

11 knees were excluded due to poor DKCT images. Of the 21 knees, 14 knees had symptoms of patellar instability and 7 knees were asymptomatic. The sensitivity of the J-sign in predicting symptomatic patellar instability was 60% (J1), 67% (J2), 100% (J3). In symptomatic knees, the percent of J3 ( $n=4$ ) in women was 100% versus no males with a J3 ( $n=0$ ). Additionally, the percent of J3 in people 24 years and older was 100% ( $n=4$ ) while no one under 24 had a J3 ( $n=0$ ) symptomatic or asymptomatic.

Conclusions:

Tanaka et al, calculated the sensitivities of each J-sign grade as following: 50% (J1), 80% (J2), 93% (J3). In a small patient population, our study validates the classification system proposed by Tanaka et al for knees with more severe patellar maltracking (J3). The sensitivity of the J-sign was particularly high for females age 24 years and older (J3=100% ( $n=4$ ), J2=100% ( $n=1$ ), and J1=0% ( $n=2$ )).

Acknowledgement: I would like to acknowledge the University of Rochester Office of Medical Education and CACHED office for funding for this project.

## Basic Science, Clinical & Translational Research

### Matthew Dernbach

Preceptors

Thomas F.X. O'Donnell, MD

Sarah E. Deery, MD

Jeremy D. Darling

Beth Israel Deaconess Medical Center

Surgical Outcomes Analysis and Research

Gabriel Yee

Jacobs School of Medicine and Biomedical Sciences University at Buffalo

Marc L. Schermerhorn, MD

Beth Israel Deaconess Medical Center

Department of Vascular and Endovascular Surgery

### **THE ASSOCIATION BETWEEN ADHERENCE TO LIPID MANAGEMENT GUIDELINES AND OUTCOMES IN CRITICAL LIMB ISCHEMIA**

**Objective:** The 2013 ACC/AHA Updated Practice Guidelines mandate the use of high dose statins in all patients <75y with critical limb ischemia (CLI), and moderate dose statins in CLI patients ≥75y without contraindications, but these recommendations are based primarily on stroke and cardiovascular data. Our aim is to validate these guidelines in patients with CLI and assess current adherence to these recommendations.

**Methods:** We identified all patients with critical limb ischemia who underwent a revascularization procedure at a single institution from 2005 to 2014. Patients were classified as high dose, moderate, low or no statin postoperatively based on ACC/AHA guidelines. Major Adverse Limb Event (MALE)-free survival, MALE, overall survival, and amputation-free survival were recorded. Cox regression was used to account for differences in baseline characteristics.

**Results:** After excluding those to whom the guidelines do not apply, we identified 874 limbs from 806 patients. Patients on statins postoperatively were older, more likely to have been on statins preoperatively, with higher rates of coronary artery disease, hypertension, diabetes, and prior myocardial infarction (all  $p < 0.05$ ). High dose statin use increased from 18% before the 2013 guidelines, to 33% afterwards ( $p$  for trend  $< 0.01$ ). In univariate analysis, high dose statins were associated with increased freedom from MALE or death (64%, 39%, and 18% at 1, 3, and 5 years compared to 65%, 36%, 19% for

low/moderate dose and 57%, 23%, 14% for no statins;  $p < 0.01$ ). Cox regression showed significantly increased freedom from MALE or death in patients on statins (HR 0.74 [95% confidence interval 0.57-0.96] for low/moderate dose,  $p = 0.03$ , and HR 0.60 [0.37-0.98] for high dose,  $p = 0.043$ ). There was a consistent, stepwise trend towards improved survival (HR 0.87, [0.63-1.20] for low/mod; HR 0.69 [0.37-1.31] in high dose) and decreased risk of amputation (HR 0.53 [0.26-1.07] for low/mod; HR 0.34 [0.09-1.26] high dose) in patients on statins, especially high dose statins. In those patients specifically mandated to be on high dose statins (those  $< 75$ y and not on hemodialysis), high dose statin use compared to low/moderate dose was associated with a 73% decrease in mortality (HR 0.27 [0.09-0.85],  $p = 0.025$ ) and 61% decreased risk of MALE or death (HR 0.39 [0.19-0.81],  $p = 0.012$ ).

**Conclusions:** High dose statin use in compliance with recent guidelines is associated with significantly decreased limb events or death. Although adherence is increasing, two thirds of eligible patients are not on high doses, a potential target for improvement.

**Acknowledgements:** I would like to thank Robert Caldwell, MD whose generosity afforded this opportunity through the Robert L. Caldwell Vascular Research Internship at Beth Israel Deaconess Medical Center. I would further like to thank Marc Schermerhorn, MD and Frank LoGerfo, MD who served as my mentors at BIDMC.

## Basic Science, Clinical & Translational Research

**Fatema Esaa**

Preceptors

Lindsey B. Dolohanty

Alice P. Pentland

Julie L. Ryan

University of Rochester Medical Center

Department of Dermatology

### THE RELEVANCE OF PROMIS MEASURES IN DERMATOLOGY

**Purpose:** Patient reported outcome (PRO) measures play an important role in clinical care and the assessment of quality of care in research, but are not commonly used in dermatology. PROMIS is a PRO measurement information system developed and validated by the NIH to assess physical, mental, and social health across all diseases and fields of medicine. PROMIS measures are domain specific but not disease specific, and can therefore follow the patient throughout the healthcare system. This study data examines the implementation and relevance of four PROMIS measures (physical function and pain interference domains in the physical health category and mood and anxiety domains in the mental health category) in dermatologic care.

**Methods:** This was a retrospective study of PROMIS data for four PROMIS domains collected by administering the PROMIS health assessment on iPads as part of clinical care. Analysis of implementation and relevance of PROMIS domains is based on patient visits from April 2016 to June 2016 at Ambulatory Clinic 2 at Strong Memorial Hospital where the assessment was administered. Patients under the age of 12 or patients unable to use an iPad or answer the questions because of physical or intellectual disability and/or deficient English language skills were excluded from this study. Physical function scores  $\leq 45$  and Pain Interference, Mood, and Anxiety scores  $\geq 55$  were described as notable. Descriptive statistics were used to assess the impact of demographic factors. An ad hoc request the URFMG was submitted in order to categorize patients by diagnosis. All statistical analyses (ANOVA, chi square and correlative analyses) were performed at significance level of 0.05 using JMP10Pro.

**Results:** PROMIS scores did vary by certain demographic factors. Age was discovered to be a confounding factor; when patients younger than 18 years of age and older than 70 were eliminated from analysis, variation in mean scores by age within each domain was no longer significant. Scores in certain domains varied by race and gender as well. ANOVA revealed that mean Physical Function and Pain Interference scores also varied



by diagnosis ( $p=0.0003$  and  $p<0.0001$ ) Even when patients younger than 18 years of age and older than 70 were eliminated from analysis, variation in mean scores was still significant ( $p<0.0001$ ). The effect of diagnosis group on a notable or not notable physical function and pain interference score was significant, even when patients  $<18$  yrs,  $>70$  yrs were excluded ( $p<0.0001$ ). While the majority of patients are not notable overall, there are more patients with notable Pain Interference PROMIS scores than other PROMIS domains and the proportion of patients with notable and not notable scores within each domain varied significantly by age, even with adjusted age groups. Patients with notable scores in the physical function and pain interference domains had a higher mean age than patients with not notable scores ( $p<0.0001$  and  $p=0.0012$ ) and those with notable scores in the mood and anxiety domains had a lower mean age than patients with not notable scores ( $p=0.023$ ,  $p=0.0279$ ) There was no significant correlation between provider and notable PROMIS scores.

**Conclusions:** The relevance of these four PROMIS domains in dermatologic care has yet to be determined. However, providers in dermatology should be aware of how demographic factors, especially age and race may be influencing patients' overall health. Dermatology patients at AC2 are more likely to experience pain interference that is significantly different from the overall population compared to the other 3 domains.

**Acknowledgments:** This research was supported by the Department of Dermatology at the University of Rochester Medical Center.

**Allison Forrest**

Preceptor

Bala Bhagavath, MBBS

University of Rochester School of Medicine and Dentistry

Department of OB/GYN

**LONG-TERM OUTCOMES OF SYMPTOM RELIEF AND FERTILITY FOLLOWING  
ROBOT-ASSISTED LAPAROSCOPIC MYOMECTOMY****Introduction:**

Uterine fibroids are the most common benign neoplasm of the reproductive track in reproductive aged women, arising from the smooth muscle cells of the myometrium. Common symptoms of fibroids include prolonged or heavy menstrual bleeding, pelvic pain or pressure, urinary frequency, and reproductive dysfunction.<sup>1</sup> Robot-assisted myomectomy presents a minimally invasive option for fibroid removal when preserving fertility may be desired. However, myomectomy may present the risk of recurrence of symptoms due to growth of new fibroids. There is currently limited available data on long-term symptom relief and reproductive outcomes following robot-assisted myomectomy.

**Objective:**

The aim of our study is to evaluate preoperative and intraoperative characteristics of patients undergoing robot-assisted myomectomy for predictive ability to inform long-term outcomes of symptom relief and fertility.

**Methods:**

We conducted a retrospective chart review and patient-reported outcome survey by abstracting medical record data and contacting patients for follow-up who underwent robot-assisted myomectomy using the daVinci Surgical System (Intuitive Surgical, Sunnyvale, CA) by the same experienced surgeon (B.B.) between January 2013 and December 2015 at Strong Memorial Hospital.

**Results:**

Survey completion rate was 48% (29 out of 60 subjects). Medical record review was conducted for 57 patients.

The mean time since myomectomy was  $19.9 \pm 10.3$  months. Increased fibroid mass was positively correlated with both increased blood loss ( $R^2=0.61$ ,  $p<0.01$ ) and

increased duration of surgery ( $R^2=0.57$ ,  $p<0.01$ ). There are no significant differences in duration of surgery or total blood loss when adjusted for fibroid mass over the course of the three years of myomectomies.

In the patient-reported outcome survey, 90% of patients report that they have not experienced any fibroid-related symptoms in the last four weeks. When asked to compare their experience with specific symptoms in the last four weeks with their symptoms prior to surgery, 51% report complete relief of all symptoms previously experienced, with a trend towards decreased symptom relief in subjects as time since surgery increases. There is also an inverse trend between those of BMI >25 and likelihood of complete symptom relief. Further, those who became pregnant following surgery trend towards reporting complete relief of all symptoms. There was no significant association between patient demographics, preoperative variables, operative variables, or postoperative fertility with complete relief of symptoms or with individual symptom relief outcomes.

A total of seven births resulted after surgery in all 29 subjects surveyed, for a birth rate of 24% in all patients. Pregnancy is achieved in 58% of those who attempted to conceive and childbirth is achieved in 42%, indicating robot-assisted myomectomy can help women achieve childbirth, including in those with prior infertility and advanced maternal age. Those who underwent myomectomy for the primary goal of improving fertility trended towards being more likely to attempt pregnancy, but less likely to have a successful birth, compared to those who underwent myomectomy for reasons other than improving fertility.

### **Conclusion:**

Complete symptom relief and pregnancy are possible following robot-assisted myomectomy. Further studies with a larger sample of patient-reported long-term outcomes is necessary in order to better predict patients who are most likely to experience complete symptom relief, relief of specific symptoms, and achieve pregnancy and childbirth following robot-assisted myomectomy.

### **References:**

1. Stewart EA. Uterine fibroids. The Lancet 2001;357:293-8.

### **Acknowledgements:**

I would like to acknowledge the Office of Medical Education for providing summer funding. Thank you to Dr. Bala Bhagavath for his mentorship and advice. Thank you to Divya Kumar and Anne Tedrow for their guidance and support.

**Ariana Goodman**

Preceptor

Roya Yumul, MD, PhD

Cedars-Sinai Medical Center

Department of Anesthesiology

**RETROSPECTIVE CHART REVIEW STUDY OF INTRAOPERATIVE KETAMINE AND METHADONE FOR LAMINECTOMY: EFFECT ON RECOVERY, POSTOPERATIVE PAIN, AND OPIOID REQUIREMENTS**

**BACKGROUND:** Post laminectomy pain is associated with increased morbidity and post operative complications and management of back pain after laminectomy often requires higher opioid baseline requirements than the general population.. Management of post operative pain with opioids may produce side effects including respiratory depression, nausea, vomiting, sedation, urinary retention, constipation, dizziness and many others that complicate post operative recovery.

**PURPOSE:** This study was a retrospective chart study that examined the intraoperative opioid requirements during a laminectomy and the their corresponding post-operative pain management requirements, side effects, vital signs, at the time they were admitted to the PACU, at 24 hours, 48 hours, and 72 hours.

**METHODS:** Data was pulled from CSHS medical record files on subjects who underwent laminectomy procedures between December 2013 and June 201. Patients were analyzed in three groups; 1) Patients who received ketamine during induction and IV infusion intraoperatively, 2) Patients who received IV methadone during pre-induction and 3) Methadone during pure induction, a bolus of IV ketamine during induction and IV ketamine infusion intraoperatively. Data collected included preoperative demographics, preoperative data (vitals, pain score, abnormal results), intraoperative data including analgesic medications, anesthetics, rescue medications and adjuncts, and postoperative data.

**RESULTS:** Significant results were not yet obtained due to limited medical student access to patient charts. Study is ongoing and will include ANOVA analysis to compare the continuous variables among the three treatment groups. When significant differences are determined, a Newman-Keuls multiple comparison test will be used to determine intergroup differences. Continuous data not normally distributed are analyzed by Kruskal-Wallis test and when significant difference is found, a Mann-Whitney U test is used for post hoc comparisons between the intergroups. Chi-squared test is used to analyze the categorical variables such as side effects and sex distribution.

**CONCLUSION:** Differences in laminectomy intraoperative administration of ketamine, methadone, or a combination of both ***may or may not*** determine post-operative recovery time, post-operative analgesic requirements, and ultimately patient satisfaction and outcome.

**ACKNOWLEDGEMENTS:** I would like to thank Dr. Roya Yumul for her continued support throughout my medical school career. I would also like to thank Dr. Barbara Davis for her confidence in me and willingness to serve as my mentor for over three years. Finally, I would like to thank the Basic/Clinical/Translational Science Faculty Advisory Committee for allowing me the opportunity to participate in research this summer.

## Basic Science, Clinical & Translational Research

### **Denzil Harris**

Preceptors

Jillian Lowell, BA

University of Rochester Medical Center

Department of Neurology

Kevin M. Biglan, MD, MPH

E. Ray Dorsey, MD, MBA

University of Rochester Medical Center

Department of Neurology

Center for Human Experimental Therapeutics

### **THE DIGITAL DIVIDE IN NEW YORK STATE: CHARACTERIZING DISPARITIES IN ACCESS TO 21<sup>ST</sup> CENTURY HEALTH CARE FOR INDIVIDUALS WITH PARKINSON DISEASE**

**OBJECTIVE:** The Greater Rochester Digital Divide study will identify and characterize barriers to care for individuals with Parkinson disease (PD) living within the Greater Rochester region (Genesee, Livingston, Monroe, Ontario, Orleans, Seneca, Wayne, Wyoming, and Yates Counties).

**BACKGROUND:** The digital divide is the growing gap between those who have access to computers and the internet, and those who do not. This divide affects various aspects of society, including the manner in which new forms of health care reach Americans today. Technological advancements in medicine, e.g., telemedicine, may serve to exacerbate current health disparities between different races, those living in urban and suburban vs. rural areas, and between the rich and poor.

**METHODS:** The role of the digital divide in local access to care for PD will be examined by: (1) exploring interests in telemedicine for individuals seeking care, (2) characterizing racial and socioeconomic factors that hinder timely care, and (3) characterizing geographic factors that hinder timely care. These aims will be explored via an in-person survey of 100 individuals self-reporting or diagnosed with PD. Voice-recorded focus groups of 4-6 individuals may be applied to characterize difficulty with local access to care, technology in the home, and interest in new modalities of care. Such focus groups would be conducted in a discussion-like setting. Patients will be identified and recruited

from local PD patient support groups, URMCAffiliated physician practices, and patient advocate groups.

RESULTS: As of August 2016, individuals meeting inclusion and exclusion criteria have yet to be enrolled into the study. Proposed recruitment strategies have been ineffective in identifying individuals in the community who receive infrequent access to care for PD. Local community outreach efforts have nonetheless identified individuals with PD interested in telemedicine.

CONCLUSIONS: Approximately 7,000 residents of the Greater Rochester region have PD and approximately 57% of these residents may not be receiving care from a neurologist. Inclusion of the IRB-approved survey questions created for this study in a regional multidisciplinary telemedicine care network (PDCNY) may help to qualitatively characterize common barriers in order to better target health care resources for this patient population.

ACKNOWLEDGEMENTS: Funding support for this project is provided by the Center for Advocacy, Community Health, Education and Diversity (CACHED) and the Medical Student Clinical Research Summer Fellowship of the Office for Medical Education.

**Stacey Isidro**

Preceptors

Mohammed Salah Mahmoudi

University of Rochester

Bonnie S. Mason, MD

Nth Dimensions/AAOS

Addisu Mesfin, MD

University of Rochester School of Medicine and Dentistry

Department of Orthopaedic Surgery and Rehabilitation

**OUTCOMES FOLLOWING HALO IMMOBILIZATION FOR CERVICAL  
SPINE FRACTURES****Study Design**

Retrospective evaluation

**Objective**

To evaluate complications and outcomes of halo immobilization in patients with cervical spine fractures treated at a Level I Trauma Center.

**Methods**

A retrospective evaluation of patients treated with halo immobilization from 8/2000 to 2/2016 was performed. Demographic information (age, gender, race), mechanism of injury, level of spine fracture, length of halo immobilization, complications associated with halo immobilization, and length of patient follow-up were collected. Inclusion criteria included halo immobilization of cervical spine fractures. Halos placed for post-surgical immobilization and for non-cervical spine fractures were excluded.

**Results**

189 patients treated with Halos were identified. 121 of the 189 patients (64%) received halos for the management of cervical spine fractures. 49.6% were males and 50.4% were females. The average age was 50.8 (1 - 89 years). 81.9% were Caucasian, 13.8% were Hispanic/Latino, 3.2% were African-American, and 1.1% were Asian.

10.7% sustained C1 fractures, 71.1% C2 fractures, and 18.2% sub-axial spine (C3-C7) fractures. Mechanism of injury included: 58.7% motor vehicle collisions and 41.3% falls.



The average length of halo immobilization was 10 weeks (0.29 - 16). The average length of follow-up was 10.9 months (0.07 - 111).

At latest follow-up, 90.2% had healed fractures with good alignment, minimal pain, and return to normal activities. There was a 9.9% mortality rate (77.8% died within 90 days of injury and 22.2% died within 1 year of injury). The mortality group had an average age of 72.4 years (49 - 88). Mechanisms for halo-related deaths included cardiac, respiratory, and renal complications. 6.6% of patients failed halo immobilization and were treated surgically. 34.7% of patients had peri-operative complications like pin site infections (9.1%), loose pins (9.1%), and neck pain (16.5%). Long-term complications included neck pain and stiffness (limited range of motion).

### **Conclusion**

The use of halo immobilization for cervical spine fractures resulted in a 90.2% success rate. In selected patients with cervical spine fractures halo immobilization can lead to successful outcomes.

### **Acknowledgement Statement for Funding Support**

We would like to thank Nth Dimensions/AAOS and the University of Rochester School of Medicine and Dentistry's Center for Advocacy, Community Health, Education and Diversity.

## Basic Science, Clinical & Translational Research

### **Jamal Jefferson**

Preceptors

Nkeiruka Umeh

National Human Genome Research Institute

Health Disparities Unit, Social and Behavioral Research Branch

Kim Smith-Whitley

The Children's Hospital of Philadelphia

Rakhi Naik

John Hopkins School of Medicine

Vence L. Bonham

University of Rochester School of Medicine and Dentistry Research Institute

### **Splenic Infarction and Sickle Cell Trait: A Review of Case Reports**

**Statement of problem/background:** Sickle cell trait (SCT) is a commonly asymptomatic condition. Although most individuals with SCT do not develop complications including clinically significant sickling, conditions of severe hypoxemia can precipitate sickling and venous or arterial compromise. Sickled erythrocytes can occlude the microvasculature of the spleen, leading to infarcts. There is a paucity of literature that comprehensively examines the risk of splenic infarction.

**Research question/hypothesis:** What factors are associated with SCT-related splenic infarction?

**Research design/methods:** Literature searches were conducted using PubMed, Embase, Scopus, CINAHL, Web of Science, and Cochrane Library for publications from 1970-2015. From the retrieved articles, only case reports and series related to splenic infarction were included. Two independent reviewers reviewed and excluded abstracts based on pre-defined criteria and full-texts of included English-language articles were assessed.

**Results/summary of investigation:** 52 cases (7 case series and 26 case reports) were reviewed. A total of 52 individuals with a mean age of 30.15 years (range of 13-65 years)

were included in the systematic review. 44 of these individuals were male and 8 were female. Of the 52 individuals, there were 14 White Americans of various ethnicities, 17 African Americans, 4 Hispanics, 8 Middle Easterners, 2 Africans, and 7 others. The geographic distribution of splenic infarct cases varied, with 26 occurring in the United States and 22 internationally. Of the cases that reported the onset of pain, half of the cases were altitude-induced (>3,000 meters, 9,842 feet), caused by either travel to a destination of high elevation (15%) or as a result of mountain climbing (35%). Presenting symptoms often included left upper quadrant abdominal and epigastric pain, nausea, and vomiting. In case reports documenting the percentage of hemoglobin S (HbS), the median percent of HbS was 40.8 (range 31.0-46.5).

**Interpretation/Conclusion:** Splenic infarction is an infrequently reported complication of SCT. Our findings support the observation that there are more frequent reports in males but do not entirely support previous observations that a higher percentage of HbS (>40%) is associated with the condition. In addition, several authors postulate that in environments of low oxygen tension, males of non-African descent are more susceptible to infarction. While we have found there to be case reports on these demographics, it is important to recognize that this may be the result of bias in the reporting of splenic infarction cases. Because case reports are valuable in generating hypotheses surrounding rare conditions, there is a need for more comprehensive reporting to better assist in the diagnosis of splenic infarction.

**Joseph Lee**

Preceptor

Beau Abar, PhD

University of Rochester School of Medicine and Dentistry

Department of Emergency Medicine

### **ACCESS TO CARE AMONG ANXIOUS AND DEPRESSED EMERGENCY DEPARTMENT PATIENTS IN MIDDLE AND OLDER ADULTHOOD**

**Introduction:** Recognition of anxiety and depressive disorders in primary care is generally poor, with only 23% of anxiety cases being recognized and 56% of depression cases.<sup>1</sup> Comorbidity of generalized anxiety disorder (GAD) and depression is also often missed and has been found to lead to greater impairment than either disorder alone.<sup>2</sup> Alongside the issue of identification is the problem of patient access to appropriate care. Patients with mental health disorders often face several barriers to effective treatment, especially among the older adult population, who report seeing mental health professionals for treatment at a lower rate than any other adult age group.<sup>3-4</sup> This study seeks to establish prevalence rates of coexisting GAD and depression among middle and older adults (45-85) presenting in the emergency department and to examine the extent to which certain barriers are perceived to play a role in accessing primary and specialized health care.

**Methods:** A brief (10-15 minutes) survey was administered to all willing participants 45-85 years old presenting in the emergency department. The questionnaire included demographic characteristics and questions on self-perceived access to health care. Screening for depression and anxiety was also performed using the PHQ-9 and GAD-7 screening tools respectively. Comparisons were analyzed with bivariate correlations.

**Results:** A total of 252 subjects both enrolled in and completed the study. The percentage of patients in the emergency department presenting with moderate depression or greater was 31%, and the percentage presenting with moderate anxiety or greater was 23%. Severe anxiety (11%) was more common than severe depression (2%). Access to care metrics were reported on a scale of 1-5. The majority of patients reported experiencing at least some barriers to care (mean=3.36, SD=0.96), with the most prominent barriers being difficulty finding transportation (mean=0.53, SD=1.16), doctor/clinic/hospital bills (mean=0.63, SD=1.19), fear that the doctor will discover a

serious illness (mean=0.55, SD=1.18), and feeling that the doctor is not responsive to patient concerns (mean=0.51, SD=1.00). PHQ-9 and GAD-7 scores showed a positive correlation with access to care mean scores ( $r=0.39$ ,  $p<0.001$ ;  $r=0.46$ ,  $p<0.001$  for PHQ-9 and GAD-7 respectively), suggesting that patients with higher levels of anxiety and depression perceived more barriers to accessing health related care. Furthermore, there was a direct positive correlation between PHQ-9 and GAD-7 scores ( $r=0.68$ ,  $p<0.001$ ), suggesting that individuals with higher levels of depression were associated with higher levels of anxiety as well.

**Conclusion:** There is a higher prevalence of depression and anxiety among middle and older adult patients presenting in the emergency department compared to that in the general population. Patients with anxiety and depression perceive increased barriers to accessing care across all domains. Prominent barriers were logistical, financial, or doctor associated. These specific barriers to healthcare can potentially be targeted to better meet patient health needs.

## References:

1. Roy-Byrne PP, Wagner A. Primary care perspectives on generalized anxiety disorder. *J Clin Psychiatry*. 2004;65 Suppl 13:20-6. Review.
2. Kessler RC, DuPont RL, Berglund P, Wittchen HU. Impairment in pure and comorbid generalized anxiety disorder and major depression at 12 months in two national surveys. *Am J Psychiatry*. 1999 Dec;156(12):1915-23.
3. Bartels SJ, Horn S, Sharkey P, Levine K. Treatment of depression in older primary care patients in health maintenance organizations. *Int J Psychiatry Med*. 1997;27(3):215-31.
4. Olfson M, Pincus HA. Outpatient mental health care in nonhospital settings: distribution of patients across provider groups. *Am J Psychiatry*. 1996 Oct;153(10):1353-6.
5. Cass AR, Volk RJ, Nease DE Jr. Health-related quality of life in primary care patients with recognized and unrecognized mood and anxiety disorders. *Int J Psychiatry Med*. 1999;29(3):293-309.

## Basic Science, Clinical & Translational Research

### **Jubin Matloubieh**

Preceptors

Thomas Osinski, MD

Benjamin Nelson, MD

Edward M. Messing, MD

David Gentile, MD

Carla Beckham, MD, PhD

URMC

Department of Urology

Janet Kukreja, MD

The University of Texas MD Anderson Cancer Center

Department of Urology

### **METABOLIC SYNDROME AND BLADDER CANCER**

**Introduction:** The metabolic syndrome (MetS) is a well characterized constellation of clinical signs and symptoms, including central obesity, insulin resistance, hypertension (HTN), inflammation and dyslipidemia. Globally the prevalence of MetS is rising and, importantly, there is growing evidence that the MetS is associated with an increased risk for several cancers, including bladder cancer. Interestingly, diabetes type II (DMII) is an independent risk factor for UBC-related death in men. The underlying biology of this elevated relative risk has not been well defined. Critically, genes involved in the glycolytic pathway (Warburg effect) have been shown to be altered in tumors and malignant cell lines and have been implicated in driving tumor formation and growth. Very little data regarding oncological outcomes for the MetS patient, such as mortality, recurrence rate, and disease-specific survival exist in bladder cancer.

**Objective:** To determine the presence of MetS in bladder cancer (CIS-T4), as well as outcomes for bladder cancer patients, including recurrence and mortality.

**Methods:** We used the Genomic Atlas data set for 131 HGMI T2-T4 UBC samples. Tumor data were processed using C-BiopPortal to investigate the relationship between genes in the glycolytic and inflammatory pathways. We evaluated clinical outcomes, including mortality and time to recurrence. Markers of MetS and oncological outcomes were evaluated and included: obesity (BMI), hypertension, hyperlipidemia/dyslipidemia,

hypercholesterolemia, DM status, and glycemic control during hospitalization, time to recurrence, and mortality.

Results: We analyzed 389 of our own bladder cancer patients 87/389 patients (22.37%) were defined as overweight by BMI at the time of their bladder cancer diagnosis, 118 patients (30.33%) were defined as obese by BMI 97/389 patients (24.94%) had DMII, 89/389 patients (22.88%) had maximum glucose levels >200mg/dl, 198/389 patients (50.90%) died (52 patients, 13.37%, with DMII), and 124/389 patients (50.90%) had a recurrence of their cancer (36 patients, 9.25%, with DMII).

Conclusions: MetS gene panel expression correlates with decreased survival and shorter time to recurrence according to analysis of TCGA UBC tumors using C-BioPortal. The fact that 25% patients had DMII disease, and 52% were obese or overweight by BMI suggests a correlation between MetS and bladder cancer. These data suggest that there may be a correlation between overexpression of the MetS gene panel and UBC. We are currently evaluating all cystectomy patients from 2002-2015 to further elucidate the connection between the MetS and UBC oncological outcomes.

Acknowledgements: I would like to thank Dr. Beckham for being a great teacher and patient mentor; Drs. Osinski and Nelson for their guidance and wisdom; and the University of Rochester School of Medicine and Dentistry's CACHED for their generous funding of my research grant.

## Basic Science, Clinical & Translational Research

### **Rachel Miceli**

Preceptors

Brett Talbot, MD

University of Rochester

Department of Radiology

Claudia Henschke, MD, PhD

The Ichan School of Medicine at Mount Sinai Medical Center

Department of Radiology

### **PULMONARY DISEASES FROM SECONDHAND TOBACCO SMOKE: INTERNATIONAL EARLY LUNG AND CARDIAC ACTION PROGRAM (I-ELCAP)**

Secondhand exposure to tobacco smoke (SHTS) is known to play a major role in morbidity and mortality worldwide. To further understand how this exposure impacts respiratory health, this project aims to provide insight to the likelihood of a broad spectrum of pulmonary diseases in a cohort of asymptomatic, never-smokers with a history of SHTS exposure. This goal will be accomplished by an examination and analysis of each screenee's lungs, as visualized by chest computed tomographic (CT) baseline and follow-up scans. Delineating the clinical implications for never-smokers who have had exposure to SHTS is vital for the proper stratification of patient risk and earlier identification and treatment of individuals with pulmonary disease. This project aims to determine the probability of specific respiratory diseases among screenees. This includes the way in which this probability relates to the indicators of risk and CT findings and quantitative lung health indices (e.g., age, SHTS exposure, nodules, other findings in the chest). Additionally, it also focuses on the effect of cessation of SHTS exposure.

A total of 7,000 screenees will undergo low-dose CT screening of the chest to reveal if SHTS exposure is an independent predictor of the development of pulmonary disease. My role primarily included expansion of the never smoker cohort exposed to SHTS and collection of relevant background information and risk indicators for pulmonary diseases. Then, a low-dose cardiac-gated baseline CT scan was performed and follow-up or further action was determined based on the CT findings and protocol. The frequency of new diagnoses as well as the progression of existing pulmonary disease in the cohort already screened will be determined by performing repeat CT screening tests after the initial baseline CT scan, as indicated. Due to the nature of screening studies, it will take many more years of data collection from follow-up scans,



as well as natural progression of disease in the screenees before the statistics can be analyzed and conclusions can be made.

The chest CT that is obtained from these patients contains a wealth of information that can be used to describe each patient's health profile beyond the lung findings. This research group is interested in the clinical implications of thoracic aortic calcium (TAC), and hepatic and pancreatic fat, all of which they have the ability to visualize and quantify in the same CT that they are obtaining for lung screening. Literature review has suggested that hepatic fat and pancreatic fat may be associated with the development of metabolic syndrome (MetS). In addition, TAC is suggested to be a predictor of non-cardiac vascular events. In the future, a better understanding of the value of TAC, hepatic, and liver fat measurements will help clinicians to gain a more complete picture of the health of their patients by using information that is readily available and easily accessible.

Funding has been provided by the Flight Attendant Medical Research Institute.

## Basic Science, Clinical & Translational Research

### **Drew Mitchell**

Preceptors

Andrew Gudeman

Indiana University School of Medicine

Robyn K. Fuchs

Stuart J. Warden

Indiana University School of Health and Rehabilitation Sciences

Department of Physical Therapy

### **INFLUENCE OF LOW-INTENSITY PULSED ULTRASOUND TREATMENT DURATION ON BONE HEALING**

Bone fractures are a frequent injury and cause of morbidity. Most fractures readily heal in presence of appropriate immobilization; however, there is a linear relationship between the duration of immobilization and negative consequences (such as joint stiffness and muscle weakness). As such, there is a need to explore ways of accelerating bone healing with the goal of reducing immobilization time. Low-intensity pulsed ultrasound (LIPUS) has been shown to accelerate fracture healing in both preclinical and clinical studies without compromising the strength of the healed bone. The current treatment paradigm consists of treating for 20 minutes per day, yet the rationale for this treatment duration remains unclear. The aim of the current study was to explore the influence of treatment duration on bone healing in drill defect model. Male Sprague-Dawley underwent surgery to produce bilateral bicortical midshaft femur drill defects with a 2 mm diameter. On the first post-operative day, one hindlimb selected at random was treated 5 d/wk with LIPUS for either 5, 10, 20, 40 or 60 minutes. The contralateral, injured leg served as an internal control. Animals were euthanized at 21 days post-operatively and the bilateral femurs were imaged using micro-computed tomography at a voxel resolution of 11.7  $\mu\text{m}$ . The original drill defect was traced and bone volume fraction (bone volume/tissue volume [BV/TV]) within the region of interest was determined. Percent side-to-side difference in BV/TV between the LIPUS and control leg was calculated within each animal and compared between treatment duration groups. LIPUS treatment for 5 min/d did not significantly benefit healing with LIPUS-to-control leg differences of 2.5% (95%CI, -1.0 to 5.9%) ( $p=0.65$ ). Treatment for 10 and 20 min/d benefitted healing, with LIPUS-to-control leg differences of 6.1% (95%CI, -1.8 to 10.4%) and 9.1% (95%CI, 4.4% to 13.9%), respectively (all  $p<0.05$ ). However, greatest benefits were observed with LIPUS treatment for 40 and 60 min/d, which induced LIPUS-to-

control leg differences of 14.0% (95%CI, 9.2 to 18.8%) and 13.5% (95%CI, 7.6% to 19.4%), respectively (all  $p < 0.05$ ). These data suggest that LIPUS treatment for 40 min/d may be superior to the current clinical paradigm of 20 min/d; however, the additional healing benefit with 40 min/d would need to be weighed against the practical limitation of doubling a patient's daily treatment duration.

## Basic Science, Clinical & Translational Research

### **Amanda Onalaja**

Preceptors

Heather Adams, PhD

Peter Morrison, DO

Jonathan W. Mink, MD, PhD

Erika F. Augustine, MD, MS

University of Rochester Medical Center

Department of Neurology (Child Neurology)

### **PATIENT AND FAMILY CONCERNS IN TOURETTE SYNDROME – A NEEDS ASSESSMENT**

#### **BACKGROUND:**

Tourette Syndrome (Tourette Syndrome or TS) is a neurological disorder characterized by repetitive involuntary movements and vocalizations called tics. In addition to tics, individuals with TS and other tic disorders often have co-morbid conditions that can include obsessive-compulsive disorder, attention deficit hyperactivity disorder, anxiety, depression, behavioral problems, and learning disabilities. This complex spectrum of co-morbid conditions often requires multi-disciplinary care and school engagement. Our goal was to better understand the health needs in TS directly from the perspective of those most impacted - patients and families from the Rochester, NY area and surrounding communities, and to determine if there were gaps in care.

#### **METHODS:**

We developed a survey to assess the opinions of affected adults and of parents or guardians of children with tics, TS, or related disorders regarding their experiences with tics and/or TS. Survey questions were developed based on literature review and review of assessments from a recently completed observational study of 100 families with a TS-affected child and 100 age-matched controls. Survey questions built upon anticipated needs based on common clinical features of TS and themes of health-related needs in other chronic conditions. The survey was developed to focus on regional health-care access, needs, and values, which upon future implementation may affect critical outcomes in the University of Rochester Tourette Syndrome Center of Excellence.

**SURVEY:**

A 39-item survey instrument was developed for adults with TS or another tic disorder, and a 47-item survey instrument was developed for parents of children with TS or another tic disorder. Each survey includes structured and open-ended responses on the following topics: demographic and educational background; utilization of and satisfaction with current medical providers and medical care, behavior therapies, and complementary/alternative treatments; co-occurring disorders; family support; and, adaptive functioning. Among respondents who endorse problems with access to healthcare or treatment, additional questions ask about potential barriers to access, including treatment costs, travel burden, and concerns of stigma.

Potential survey respondents will be recruited from among patients of the UPMC neurology/TS clinic and from the UPMC Tourette Syndrome Research Contact Registry. We will also partner with local and regional chapters of the Tourette Association of America, primary care and pediatric providers, college and university health clinics, and local newspapers to disseminate information regarding the study. Study enrollment and participation will take place online using Research Electronic Data Capture (REDCap) software. REDCap is a secure, web-based data collection tool that will allow respondents to provide direct data entry in an anonymous manner.

The survey data will be analyzed for commonly endorsed themes; using parametric versus non-parametric analysis approaches as indicated, these themes will determine whether patient needs differ based on demographic factors or specific associated medical conditions. The data collected from this needs assessment will help to bridge the gap for patients and their families impacted by tics or TS.

**Acknowledgement Statement:**

Funding for the research project was provided by the Center for Advocacy, Community Health, Education and Diversity and the Office of Medical Education.

**Kiran Nandigam**

Preceptors

Pavel Nosovitskiy

Stanford University

Department of Information Technology and Services

Suzanne Karan, MD

University of Rochester

Department of Anesthesiology

**USE OF ELECTRONIC-NOSE SENSORS IN DETECTING END-TIDAL  
PROPOFOL LEVELS**

There are currently no methods to measure exact live propofol levels in a patient who is undergoing anesthesia, despite the fact that this is a commonly administered intravenous anesthetic. Generally, propofol levels are estimated based on algorithms determined from studies done in similar patients and are based on weight, age, and gender. Measurements of actual plasma (or effect site) concentrations are not currently feasible and titration is mostly performed based on pharmacodynamic estimations of presumed context sensitive half-lives. In contrast, volatile anesthetic levels are continuously measured in end tidal (end of breath) gas concentrations, approximated to brain site concentrations due to rapid equilibrium, and provide a dynamic estimation of anesthetic depth. In order to meet this clinical need, we have worked on creating a gas-measuring device that continuously measures gas compound concentrations.

The device in creation entails the commonly used Figaro Sensor, featured in many air quality control applications, to measure changes in electrical charge dissipation. Our set up using this sensor is housed in an enclosed environment and is able to detect specific levels of applied gases with an accuracy comparable to a large device (such as a mass spectrometer) in a much more portable unit. Recent studies have shown that gas profiles from end of breath are being used to detect metabolites as early indicators of chronic diseases. We foresee the application of our portable device for measurements in multiple settings.

Initial studies have been focused on fine tuning algorithmic coding to measure specific gas concentrations. To date, we have calibrated this algorithm for the measurement of air, oxygen, ultrapure nitrogen, ethanol and acetone. The process of gas measurement calibration consisted of measurements at a variety of times, flow levels, and

concentrations. Primary trials are three minutes long with voltage and current data recorded at 5Hz. As we have continued to improve the accuracy of the device, we plan to next examine the measurement of aerosolized propofol, in vitro. Following this phase of testing, we plan on in vivo testing of controlled propofol concentrations in humans with clinical trials. Additionally, the device will eventually be tuned to detect metabolites seen in early screening detection of diseases, such as for breast cancer via breath metabolites.

**Acknowledgement Statement:** The student in this research project received funding from the University of Rochester Office of Medical Education. The student will continue further work with the device creator as well as the principal investigator.

**Andrew Pan**

Preceptors

Shannon M. Smith

Jennifer S. Gewandter

Rachel A. Kitt

University of Rochester School of Medicine and Dentistry

Department of Anesthesiology

Robert H. Dworkin

University of Rochester School of Medicine and Dentistry

Department of Anesthesiology

Department of Neurology, Psychiatry, and Center for Human Experimental Therapeutics

**META-ANALYSIS OF THE EFFECT SIZES FOR WORST AND AVERAGE PAIN  
INTENSITY IN RANDOMIZED CLINICAL TRIALS OF TREATMENTS FOR CHRONIC  
PAIN CONDITIONS**

The Analgesic, Anesthetic, and Addiction Clinical Trial Translations, Innovations, Opportunities, and Networks (ACTION) public-private partnership with the U.S. Food and Drug Administration (FDA) aims to optimize the conduct of pain, sedation, and addiction clinical trials to expedite the discovery and development of improved treatments. The FDA's draft guidance for analgesic indications recommends the use of worst pain intensity as the primary outcome variable in pain treatment trials. However, no empirical evidence of which we are aware supports the use of worst pain intensity over average pain intensity to identify efficacious analgesics. To this end, we conducted a systematic review of all randomized clinical trials published between 1980 and 2015 for the treatment of low back pain, osteoarthritis, diabetic peripheral neuropathic pain, postherpetic neuralgia, or fibromyalgia. Eligible articles reported comparisons between an efficacious treatment and a placebo group for both average and worst pain intensity ( $n = 30$ ). Standardized effect sizes (SES) for average and worst pain intensity were extracted from the articles when reported, or were calculated from reported data. We performed a random effects meta-analysis to examine whether average or worst pain intensity had a higher SES. We found that the estimated mean difference between average pain intensity and worst pain intensity was  $-0.030$  (95% Confidence Interval:  $-0.058$  to  $-0.003$ ), which was statistically significant in favor of average pain intensity ( $P = 0.042$ ). These results suggest that pain



clinical trials might have greater sensitivity for detecting efficacious treatments if average pain intensity is used as the primary outcome variable.

Acknowledgements: A.J.P was supported by a summer fellowship from the Office for Medical Education at the University of Rochester School of Medicine and Dentistry. Financial support for the larger project was provided by the Analgesic, Anesthetic, and Addiction Clinical Trial Translations, Innovations, Opportunities, and Networks (ACTTION) public-private partnership with the U.S. Food and Drug Administration (FDA). ACTTION has received research contracts, grants, or other revenue from the FDA, multiple pharmaceutical and device companies, and other sources. No official endorsement by the FDA or the pharmaceutical and device companies that have provided unrestricted grants to support the activities of ACTTION should be inferred.

### Alap Patel

Preceptors

Zhaomin XU, MD

Fergal Fleming, MD

University of Rochester Saunders Research Building

Surgical Outcomes and Research Enterprise

### **C-REACTIVE PROTEIN (CRP) IN COLORECTAL RESECTION PATIENTS AS A PREDICTOR OF 30, 60, AND 90-DAY READMISSION AND MORTALITY RATES**

**Introduction:** C-reactive protein (CRP) levels in blood acts as a predictor of adverse outcomes in patients who've undergone colorectal resection surgery. CRP is released by the liver in response to cytokines, and increases rapidly in response to inflammation and infection<sup>1</sup>. Clinically, CRP is significant as an early predictor of infection following pancreatic, esophageal, and colorectal resection surgeries<sup>2</sup>. One study finds a strong dose-response relationship between colorectal cancer deaths and CRP levels<sup>3</sup>. Another study found that CRP, as a pre-treatment marker, could predict prognosis; the study found that survival rate was worse in groups with higher CRP levels before undergoing chemotherapy for unresectable metastatic colorectal cancer<sup>4</sup>. The importance of CRP as a predictor of adverse outcomes is seen internationally as well. The Cancer Research journal published a 2006 study that looked at 260 controls and 130 cases of colorectal cancer in males via the Finnish Cancer Registry, finding that CRP levels were 25% higher in colorectal cancer cases, and that the highest quartile of controls was at an increased risk of developing colorectal cancer<sup>5</sup>. With the importance and relevance of CRP already established, our study specifically aimed to understand the relationship between CRP and readmission & mortality at post-operative days (POD) 30, 60, and 90 in our patient cohort, which included both malignant and benign cases.

**Methods:** Following Internal Review Board approval, a patient list was obtained including all patients who had undergone colorectal resection between 2012 and 2015. Patients under the age of 18, found to not have undergone an operative resection, or patients without a minimum of three post-operative day CRP values were excluded from our study. 610 patients were found to meet include criteria. These patients were then queried through the i2b2 database for CRP values and demographic data. Statistical Analysis System (SAS) was used for statistical analysis.

**Results:** Our predominantly female (52%) cohort had an average age of 57.8, an average length of stay of 10 days, and an average post-operative complication rate of 0.08 per 100. The most common resection procedures were a partial or subtotal colectomy (67.9%), low anterior resection (LAR) total proctectomy (9.3%), and total colectomy (8.7%). Average CRP values (mg/L, normal 0-10 mg/L) for the entire patient cohort, by post-operative day starting at POD 1, were 40.8, 119.4, 130.2, 105.7, 94.8, and 92.6. In the 22 readmissions by POD 30, the average CRP level was 135 mg/L; in the 10 deaths by POD 30, the average CRP was 136 mg/L. In the 49 readmissions between POD 31 and 60, the average CRP level was 162 mg/L; there were 0 deaths from POD 31 to 60. In the 22 readmissions between POD 61 and 90, the average CRP level was 178 mg/L; in the 1 death the CRP was 179 mg/L.

**Conclusion:** There is an upward trend in the average CRP value in those readmitted at POD 30, 60, and 90, with a decrease in the quantity of deaths as we move from POD 30 to 90. Previous papers note that the CRP value should peak around POD 2-4, and then begin to steadily decline, given that the patient is adequately healing<sup>1,6-8</sup>. The most readmissions were seen in the POD 31 to POD 60 time period, suggesting causes of readmission may be related to incidents in the healing process further down the post-operative time course. Further analysis should focus on differences in procedure type and CRP values, and their relationships to readmission and mortality, if any.

**Acknowledge:** I'd like to thank the Office of Medical Education for their generous funding of this project.

#### References:

- <sup>1</sup> Du Clos, Terry. "Function of C-Reactive Protein." *Annals of Medicine* 32.4 (2000): 274-8.
- <sup>2</sup> Silvestre, Joana; et al. "Diagnostic Accuracy of C-Reactive Protein and Procalcitonin in the Early Detection of Infection After Elective Colorectal Surgery? A Pilot Study." *BMC Infectious Diseases* 14 (2014): 444.
- <sup>3</sup> Goyal, Abhishek; Terry, Mary Beth; et. al. "C-Reactive Protein and Colorectal Cancer Mortality in U.S. Adults." *Cancer Epidemiology Biomarkers & Prevention* 23.8 (2014): 1609-18.
- <sup>4</sup> Shibutani, M.; Maeda, K; et. al. "Significance of Markers of Systemic Inflammation for Predicting Survival and Chemotherapeutic Outcomes and Monitoring Tumor Progression in Patients with Unresectable Metastatic Colorectal Cancer." *Anticancer Research* 35.9 (2015): 5037-46.
- <sup>5</sup> Gunter, Marc; Stolzenberg-Solomon, Rachael; et. al. "A Prospective Study of Serum C-Reactive Protein and Colorectal Cancer Risk in Men." *Cancer Research* 66 (2006): 2483.
- <sup>6</sup> Mackay GJ, Molloy RG, O'dwyer PJ. C-reactive protein as a predictor of postoperative infective complications following elective colorectal resection. doi:10.1111/j.1463-1318.2010.02236.x.
- <sup>7</sup> Watt DG, Horgan PG, McMillan DC. Routine clinical markers of the magnitude of the systemic inflammatory response after elective operation: A systematic review. *Surg (United States)*. 2015. doi:10.1016/j.surg.2014.09.009.
- <sup>8</sup> van der Stok EP, Grünhagen DJ, Rothbarth J, Verhoef C. The Prognostic Value of Post-operative Serum C-reactive Protein Level for -Survival after Surgery for Colorectal Liver Metastases. *Acta Chir Belg*. 2015;115(5):348-355. doi:10.1080/00015458.2015.11681127.

## Basic Science, Clinical & Translational Research

### **Irene Perez**

Preceptors

Katherine Minson

Madeline Huey

Deborah Deryckere

Douglas Graham

Children's Healthcare of Atlanta

Aflac Cancer Center

Emory University

Department of Pediatrics

Craig Mullen

University of Rochester School of Medicine and Dentistry

Department of Pediatrics

### **ROLE OF STAT5 AND GAS6 IN MEDIATING RESISTANCE TO MRX-2843 IN ACUTE MYELOID LEUKEMIA**

New, molecularly-targeted therapies with fewer side effects are needed for the treatment of Acute Myeloid Leukemia (AML). One potential target is MERTK, a member of the TAM (TYRO-3, AXL, MERTK) family of receptor tyrosine kinases that is aberrantly expressed in 80-90% of pediatric and adult AML patient samples. In patient-derived xenograft models of AML, inhibition of MERTK using shRNA or a MERTK-selective tyrosine kinase inhibitor, MRX-2843, resulted in decreased tumor burden and increased survival. However, MRX-2843 induced tumor cell killing was limited in the bone marrow; a well-documented protective niche for leukemia cells. Preliminary in vitro studies indicate that Gas6, a ligand for TAM receptor tyrosine kinases secreted by bone marrow stromal cells, is involved in mediating MRX-2843 drug resistance. Here, we observed that pSTAT5, a canonical oncogenic pathway, is significantly upregulated in harvested protein lysates from leukemia cells co-cultured with human bone marrow stromal cells compared to leukemia cells alone (n=3). Interestingly, MRX-2843 inhibited STAT5 activation in leukemia cells, but was insufficient to inhibit this activation when leukemia cells were co-cultured with human bone marrow stromal cells. To assess the role of Gas6 in STAT5 upregulation, 1 $\mu$ M of AxlFc, a Gas6 inhibitor, was added to the co-culture of leukemia cells and human bone marrow cells. Similar to treatment with MRX-2843, pSTAT5 upregulated levels were unchanged (n=3). Dual inhibition of MERTK and STAT5 with MRX-2843 and pimozone on co-cultured leukemia cells with human bone marrow stromal cells was evaluated by

measuring the induction of apoptosis following 72 hours of treatment using flow cytometry. Treatment with 300 nM of MRX-2843 alone and in combination with 20 $\mu$ M or 30  $\mu$ M of pimozide resulted in similar levels of apoptosis. Clonogenic cell survival assays evaluating the effects of MRX-2843 on human and mouse bone marrow stromal cells demonstrate minimal to moderate non-specific inhibition of colony formation. These results suggest additional key players in conjunction with STAT5 are involved in mediating MRX-2843 drug resistance in leukemia cells. Further shRNA and kinase library screening studies need to be conducted to identify other interacting pathways. The Sanford Meyerowitz Research Fellowship funded this project.

## Basic Science, Clinical & Translational Research

### Jordan Powell

#### Preceptors

Lisa Moreno-Walton, MD

Jennifer Avegno, MD

Ebony Juakali, MD

Julie Pasternack, MD

University of Rochester Medical Center

Department of Emergency Medicine

### **A SURVEY INVESTIGATION OF THE IMPACT OF INSURANCE REQUIREMENTS ON THE INFLUX OF PATIENTS IN AN URBAN EMERGENCY DEPARTMENT**

**Objectives:** This study examined whether the influx of patients coming into the Emergency Department (ED) is as a result of lack of resources in the community and lack of access to their Primary care provider (PCP).

**Background:** In March of 2010, Legislation passed the health care reform act. The CDC reports that from 1995 to 2014 the number of individuals that visit the ED has significantly increased from 95, 000 individuals in the age range of 19-65 years to 136 million.

**Methods:** A brief survey was developed by a student researcher after researching the ED and the patients demographic at University Medical Center in New Orleans, LA. The survey was conducted in the ED in July of 2016 to determine if there are trends in chief complaints, insurance, their accessibility to a PCP and barriers to healthcare. One hundred and fifty individuals (male and female) of all ethnicities between the ages of 18-65 were asked to participate. A verbal and written consent was given to each patient. Individuals with altered mental status, unstable vitals, prisoners, those not able to consent, or those who refused were excluded from the study.

**Results:** Out of the total number of samples, 82.7% of individuals seen in the ED were seen for non-emergent complaints. Fifty- four percent of patients stated that they were insured after 2010.

Thirty-eight percent of individuals that participated in the study experienced challenges of receiving healthcare. Of the various challenges to healthcare, 22.7% stated that transportation prevented them from seeking healthcare. Thirty-eight percent of individuals were not able to receive healthcare availability. Of those 38% failing to receive PCP availability, 54% admitted that this resulted in an ED visit. Another 58.7% of individuals admitted that they have not been able to receive primary care in a timely

manner that has resulted in an ED visit. Of the 82% of non-emergent patients coming into the ED, we find that 55% are insured and seeking the ED rather than primary care in the community. We observed that 63% of individuals that were insured after March of 2010 came to the ED because they were unable to be seen by a PCP in a timely manner. Thirty percent of individuals that were newly insured were not able to access a PCP. Of those 30%, fifty percent claimed that this inconvenience resulted in an ED visit.

**Conclusion:** While the Affordable healthcare act helped so many in gaining affordable healthcare, it has also pressured the ED with patients unable to access the primary care system. Although millions of Americans obtained health insurance following the enactment of the Affordable Care Act (ACA), shortages of primary care physicians and other office-based doctors left many patients with limited access to care [4]. Many Emergency Departments are packed with patients who are uninsured with no other resources for healthcare, or have healthcare and add to the burden since they are unable to see their Primary care provider in a timely manner. For most, the emergency department is their only means of seeking healthcare. For others, the emergency department serves as a means of convenience.

**Acknowledgments:** I would like to thank Sanford Meyerowitz Research Fellowship and G&C for funding the opportunity for me to complete this research project at UMC in New Orleans, LA.

## Basic Science, Clinical & Translational Research

**Michael Saulle and Edward Daingerfield**

Preceptors

Ryan Bodkin, MD

Courtney Jones, PhD

University of Rochester Medical Center

Department of Emergency Medicine

### **THE AVERAGE HIKER'S KNOWLEDGE OF ALTITUDE SICKNESS ALONG THE COLORADO TRAIL**

Armed with the appropriate knowledge, hikers can avoid altitude sickness and mitigate its symptoms if they arise. In order to successfully inform the hiking community about methods of prevention and treatment of altitude sickness, a baseline knowledge of the topic within the hiking community must first be assessed.

Hikers encountered during a thru-hike of the Colorado Trail from June 19<sup>th</sup>, 2016 – July 24<sup>th</sup>, 2016 were approached and screened for eligibility. Following informed consent, those who met inclusion criteria were interviewed using a standardized questionnaire. Follow-up questions were used to clarify responses or to elaborate on specific statements made by subjects. The researchers documented responses to each of the pre-defined survey questions and took detailed notes throughout the interview. The interviews were audio-recorded and then transcribed. Survey questions included demographics, self-reported hiking ability and experience, as well as questions regarding knowledge of the symptoms of and ways to prevent and treat altitude sickness. Data were then entered into a database using a standard data entry protocol. Analysis was performed using standard descriptive statistics to characterize the study sample and responses to survey questions.

A total of 51 hikers were recruited and completed the interview. The majority of the study sample were aged 18 to 25 years (43%) and 27 were male (52.9%) and of white race (96.1%). When asked to describe their previous hiking ability and experience level, 35.3% self-described as being advanced, 51.0% self-reported hiking more than 20 times per year, and 56.9% self-reported hiking above 8,000 feet on more than 20 occasions. Worrying about altitude sickness was only endorsed by 35.3% of the study sample. Of the 51 subjects interviewed, 29 (56.9%) had previously experienced altitude sickness, with 20 (69.0%) indicating their illness was mild or minor and 9 (31.0%) indicating it was moderate or severe. Of these 29 subjects who reported previously experiencing altitude sickness, none of whom sought medical attention. Subjects were



able to correctly identify symptoms of altitude sickness. The majority of subjects (98.0%) were able to identify at least one correct symptom of altitude sickness. The most frequently reported correct symptoms of altitude sickness were vertigo, headache, fatigue, nausea and disorientation. However, when asked to identify the correct methods to prevent and treat altitude sickness only 80.4% and 66.7%, respectively, could identify at least one correct method. The most frequently reported correct prevention method was to acclimate and the most frequently reported correct treatment method was to descend. In addition, a number of incorrect answers were provided including hydration, non-prescription medications (e.g., ibuprofen, aspirin, etc.), and deep breathing.

Many hikers are able to identify altitude sickness, while fewer are aware of effective treatments. In order to help prevent hiker injury due to altitude sickness, educational efforts should focus on informing hikers of effective treatments of altitude sickness.

We would like to thank the Office of Medical Education at the University of Rochester School of Medicine and Dentistry for funding this project.

**Erin Schikowski**

Preceptor

Edward Puzas, PhD

University of Rochester School of Medicine and Dentistry

Department of Orthopaedics

## **TOWARD IDENTIFYING NEW RISK FACTORS FOR FAILED FUSION SYNDROME**

### **Background**

Each year over 200,000 patients with painful back conditions—from lumbar disc degeneration to cervical radiculopathy—undergo vertebral fusion surgery to reduce the discomfort caused by motion of the spine. During these procedures, damaged intervertebral discs are removed and adjacent vertebral bodies are fused using bone graft to create a solid fusion mass between the vertebrae. The formation of this mass and, thus, the success of the surgery, depend largely on whether the graft stimulates sufficient osteogenic bone formation at the site of fusion.

Unfortunately, non-union rates following spinal fusion surgery range from 10%–40%. In “failed fusion syndrome,” these non-unions are not fully explained by known risk factors such as pre-existing metabolic disease, smoking, drug use, osteoporosis, steroids, and scar tissue formation. One aspect of the procedure that could be a risk factor for non-union is the quality of the bone graft itself. Surgeons currently use both autologous bone grafts and cadaveric allografts, which are screened for HIV, Hepatitis B, Hepatitis C, and Syphilis. Lead content, however, is not routinely measured even though it is known to reduce osteoblast activity and inhibit bone formation in animal models.

In this study, we evaluated the lead content in bone taken from patients who underwent hip replacement surgery at Strong Memorial Hospital. Our aim was to determine whether there was a significant difference in cortical versus trabecular lead levels, with the intention of using this as background information to guide future research into the effects of lead on fusion mass consolidation.

### **Methods**

Bone samples from 61 patients were obtained during hip-replacement surgeries performed at Strong Memorial Hospital. The tissue samples were placed in plastic containers in the operating room, collected by study staff, and transported to the Center for Musculoskeletal Research, where they were washed in phosphate-buffered saline at pH 7.4 and stored in 10% formaldehyde at 4°C. Once all the samples had been collected,

they were thawed to room temperature. Trabecular bone was separated from cortical bone using a Dremel 7700 7.2V MultiPro rotary tool.

The samples were then dried and weighed. Lead levels were determined by the Department of Environmental Medicine using a Perkin-Elmer PinAAcle 900Z atomic absorption spectrophotometer equipped with longitudinal Zeeman background correction and a transverse heated graphite furnace (Perkin-Elmer Life and Analytical Sciences, Shelton, CT 06484 USA). Lead absorption was measured at 283.3 nm using a Perkin-Elmer System 2 electrodeless discharge lamp source.

## **Results**

Within subjects, the lead content in cortical bone was significantly higher than that of trabecular bone, with a mean difference of 0.760 ug Pb/g bone ( $p < 0.001$ , 95% CI 0.431–1.09). Frequency distributions for both cortical and trabecular lead levels were left-skewed, with the majority of patients exhibiting levels under 1 ug Pb/g bone in both cortical and trabecular specimens.

## **Conclusions**

If lead plays a role in fusion mass consolidation, its effect would be more readily apparent in patients receiving bone graft material comprised of cortical rather than trabecular bone. This background knowledge will allow for better study design of future experiments investigating the effects of lead on fusion mass consolidation.

## **Acknowledgment**

We thank Bob Gelein for his assistance in measuring bone lead levels and the Office of Medical Education for funding this study.

**Nicholas Searcy, MBA**

Preceptors

Amber Melvin, MD

Juan Siordia, MD

Peter Knight, MD

University of Rochester Medical Center

Department of Surgery – Division of Cardiac Surgery

## **ANTICOAGULATION FOR GENERAL SURGERY IN PATIENTS WITH A LEFT VENTRICULAR ASSIST DEVICE**

### **Introduction**

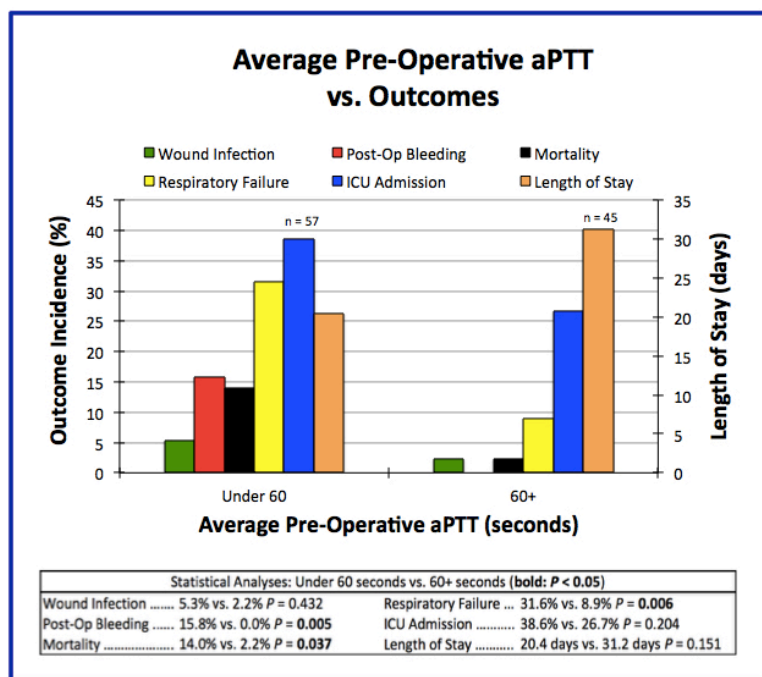
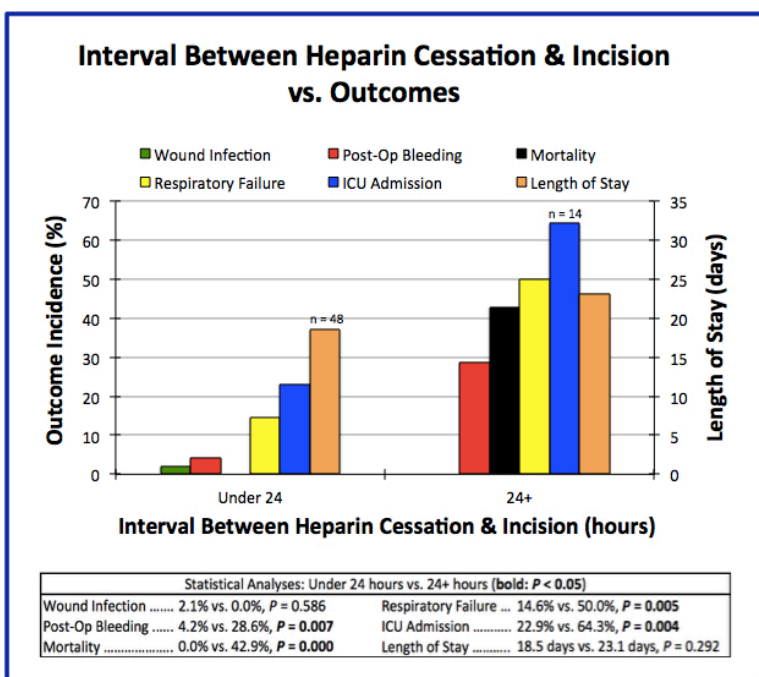
Increased expertise and experience of health care providers coupled with technologic improvements have resulted in enhanced post-implant survival in left ventricular assist device (LVAD) recipients. Consequently, increasing survival has allowed for growing numbers of LVAD patients to undergo non-cardiac surgeries (NCS) as needed.<sup>1-7</sup> Our objective is to evaluate general surgical outcomes of LVAD-implanted patients as they relate to perioperative anticoagulation management.

### **Methods**

A retrospective review was completed for 172 individuals with LVADs implanted from 2010-2016 who underwent elective NCS. Pre- and post-operative anticoagulation strategy was analyzed. The primary outcome was post-operative bleeding requiring a return to the operating room. Secondary outcomes were respiratory failure, wound infection, ICU admission, mortality, and hospital length of stay. Pre-operative aPTT levels were reported as an average for the three-day period immediately prior to incision. Levels were recorded insomuch as pre-operative lab data was available and as long as heparin administration remained unchanged during this time.

## Results

Heparin cessation within 24 hours of incision time was associated with lower incidences of post-operative bleeding, respiratory failure, ICU admission, and mortality (4.2% vs. 28.6%  $P = 0.007$ , 14.6% vs. 50.0%  $P = 0.005$ , 22.9% vs. 64.3%  $P = 0.004$ , and 0.0% vs. 42.9%  $P = 0.000$  respectively). Also, an average pre-operative aPTT of 60 seconds or more was associated with less post-operative bleeding, respiratory failure, and mortality (0.0% vs. 15.8%  $P = 0.005$ , 8.9% vs. 31.6%  $P = 0.006$ , and 2.2% vs. 14.0%  $P = 0.037$  respectively).



Patients with a previous history of cerebrovascular accident (CVA) experienced increased post-operative bleeding, respiratory failure, ICU admission, and mortality (9.8% vs. 2.7%  $P = 0.044$ , 23.0% vs. 9.9%  $P = 0.020$ , 34.4% vs. 16.2%  $P = 0.006$ , and 11.5% vs. 2.7%  $P = 0.017$  respectively). Additionally, patients who underwent LVAD implantation for destination therapy experienced more post-operative bleeding (8.9% vs. 1.2%  $P = 0.024$ ) than did patients with an indication for bridge-to-

transplant.

## Conclusions

Pre-operative heparin management in elective NCS appears to favor a more aggressive approach in LVAD patients. This is evident with the decrease in adverse primary and

secondary outcomes when heparin administration is continued into the 24-hour window prior to incision and when the average pre-operative aPTT is held to 60 seconds or above.

Patients with a past history of CVA and patients with an LVAD implant indication for destination therapy comprise significant subpopulations of LVAD recipients who undergo NCS. Consequently, it is likely that surgeons will interact with these individuals in a professional capacity. Therefore, surgeons must be mindful that these subpopulations are partially characterized by an increased propensity for post-operative bleeding in elective NCS and take anticipatory steps to mitigate associated complications.

### **Acknowledgements**

This project was funded through a combined grant from the University of Rochester Center for Advocacy, Community Health, Education, and Diversity and the U.S. Federal Work-Study Program.

**Shima Tafreshi**

Preceptors

Brandon Surr, MD, MSE

Susan Hobbs, PhD

University of Rochester Medical Center

Department of Imaging Services

**THORACIC MANIFESTATIONS OF METASTATIC HEPATOCELLULAR CARCINOMA**

This project aims to analyze the imaging features and time period for metastatic manifestation of HCC in the thorax and to correlate the findings with intra-abdominal tumor staging based on abdominal CT or MR findings. The ultimate goal of the project is to establish surveillance thoracic imaging guidelines for patients with HCC based on the time period of thoracic metastasis since their initial HCC diagnosis.

Hepatocellular carcinoma (HCC) is the most common form of primary liver cancer. Only a minority of patients with HCC is suitable for the current curative treatment options available including surgical resection, liver transplant, and percutaneous ablative therapies. HCC can progress and lead to extrahepatic and intra-abdominal metastasis. Because of the progress made in different diagnostic imaging studies including ultrasonography (US), computed tomography (CT), and magnetic resonance imaging (MRI), the sensitivity of liver cancer detection and early detection for high-risk patients has significantly improved. Patients with HCC may undergo chest CT scans as a part of initial or re-staging work-ups. Currently, there is no guideline in place for detection of thoracic HCC metastasis, even though previous studies showed that the thorax, especially, the lungs, is the most common site for metastasis outside the abdomen. Assessing time period and patterns for metastasis in the thorax can help determine appropriate time period for restaging scan or reduce unnecessary short-term surveillance scan for patients with low-stage HCC.

In this retrospective study, 310 patients with the diagnosis of HCC who underwent chest CT scans between January, 2009 and June, 2016 were identified and included in this study. Their chest CT scans were reviewed to identify patients with thoracic metastasis. The patients' initial abdomen CT or MRI scan and medical records were reviewed to determine the date of the initial HCC diagnosis as well as the extent of HCC in the abdomen. In addition, if the patient had undergone liver biopsy for confirmation of HCC, the date of the liver biopsy was recorded.

In our review, total 27 patients were found to have thoracic metastases based on chest CT findings, presenting as thoracic lymphadenopathy, bone lesions, or pulmonary

nodules. Overall, initial staging or surveillance CT scans led to detection of extrahepatic metastasis in 8.7 % of patients with HCC. The most common pattern of thoracic metastasis was pulmonary nodules (62.9%). However, isolated lymphadenopathy (44%) or bony metastasis (14.8%) involving the ribs or thoracic spine was also seen.

Our study shows that staging and surveillance chest CT for HCC can reliably detect thoracic metastasis. Currently, there exists no guideline for imaging surveillance for possible thoracic HCC metastasis. Given substantial number of patients developing thoracic metastasis and various metastatic patterns, it is valid to include chest CT study as a part of follow-up imaging protocol for HCC. Further analysis of these patients based on their intra-abdominal staging and prior treatment will help determine appropriate time interval for surveillance scan.

Acknowledgements: I would like to thank Dr. Hobbs for guidance and support in the planning and execution of this project, and Dr. Sur for advice and assistance with the organization and interpretation of the results. I would like to thank Dr. Morgan for her tremendous support and the Office of Medical Education for providing me with funding to make this project a possibility.



**Joseph Van Galen**

Preceptors

Matthew Luther

Nguyen Mai

Marc W. Halterman

University of Rochester School of Medicine and Dentistry

Center for Neural Development and Disease

Mark Nelson

Echelon Biosciences Inc.

**DEVELOPMENT OF A HIGH-THROUPTUT SCREEN FOR NOVEL CYTOPROTECTIVE  
SUBSTITUTED TETRACYCLINES**

While best known for their utility in infectious diseases, tetracyclines (TCs) possess both anti-inflammatory and cytoprotective properties in a range of human diseases. Although the second-generation agents doxycycline (DOX) and minocycline (MINO) exert neuroprotective effects in acute stroke, global cerebral ischemia, and traumatic brain injury, none have advanced from clinical trials to use in practice. The goal of this study was to design and validate a high throughput, live-cell screening system based image cytometry that could be used to identify non-toxic, neuroprotective fourth generation tetracycline derivatives. Immortalized murine neurons (HN33) were cultured in 96-well plates under standard conditions. To discern live from dead cells, parallel plates were treated with the live-cell marker calcein AM (3  $\mu$ M), or the cell-death marker ethidium homodimer (3  $\mu$ M) for 30 minutes before imaging on the Nexcelom Bioscience Celigo S system. Relative to untreated cells, staining with either dye produced relatively low-level fluorescence, with puncta of more intense fluorescence dispersed throughout the cell population. As a positive control, cultures were treated with hydrogen peroxide; treatment was paradoxically found to increase whole-well fluorescence signal. This suggests that excess toxicity was triggered. Ongoing work will assess variables including cell density and dye loading concentration and time, as well as alternate methods of inducing cell death, to optimize the utility of this image-based screening platform.

Acknowledgements: JVG thanks MWH for guidance and support in the planning and execution of the project, and ML and NM for advice and assistance at the bench. Support to JVG was provided through the Schmitt Program for Integrative Brain Research; work was further supported by funds from the Schmitt Foundation (GR523695) to MWH.

**Kwanza Warren**

Preceptors

Matthew Walker, MS

University of Toronto

Institute of Medical Science

Mojgan Hodaie, MD, MSc, FRCS(C)

Toronto Western Hospital

Department of Neurosurgery

**DTI IMAGING OF TRIGEMINAL NERVE FOR COUPLING WITH  
FOCUSED ULTRASOUND**

**BACKGROUND:** Trigeminal neuralgia (TN) is a common form of neuropathic facial pain in adults. For patients with TN who are not responsive to medications, several surgical techniques have been developed to relieve the symptoms of this debilitating disorder. Each of these techniques has associated risks and benefits. Magnetic Resonance-guided Focused Ultrasound (MRgFUS) is a promising, non-invasive technique that applies high intensity, focused ultrasound energy to heat and ablate tissue. The use of this technique in neurosurgery presents some unique challenges, including accurate visualization of target tissue using conventional methods. Diffusion Tensor Imaging and 3D tractography can be used to better visualize structures for more accurate assessment of target tissue and nerve distributions. The purpose of this study is to characterize the relationship between DTI and FUS treatment of the trigeminal nerve by assessing diffusion measurements before and after FUS treatment in a porcine model.

**METHODS:** Four trigeminal nerves were identified in post-mortem (< 24 hrs) piglets on Diffusion-weighted MRIs. 3D Tractography was done on the root entry zone of each nerve in the 3D Slicer program, and the following diffusion parameters were collected: trace, fractional anisotropy, parallel diffusivity and perpendicular diffusivity. Each of these parameters was assessed before and after FUS treatment of the trigeminal nerve.

**RESULTS:** Results showed a decrease in fractional anisotropy and increases in trace, parallel diffusivity and perpendicular diffusivity following FUS treatment.

**CONCLUSIONS:** FUS treatment was shown to decrease fractional anisotropy and increase trace, parallel diffusivity, and perpendicular diffusivity of the trigeminal nerve. These changes are all consistent with the breakdown of the nerve fibers, which allows the diffusion of water to become less directionally dependent as the integrity of the axons are compromised. These results show that FUS is an effective method of ablation of the trigeminal nerve, and this treatment corresponds with the diffusion parameters outlined above.

*Acknowledgements: I would like to acknowledge the Office of Medical Education at the University of Rochester School of Medicine and Dentistry for the funding to complete this project. I would also like to thank Dr. Mojgan Hodaie, and Matthew Walker who provided guidance and support throughout this process.*

## Basic Science, Clinical & Translational Research

**Katherine Wegman and Lauryn Hemminger**

Preceptors:

Michael Keefer, MD

Catherine Brice, MS

University of Rochester

Department of Infectious Disease

John Cullen, PhD

University of Rochester Clinical and Translational Science Institute

### **BARRIERS TO PARTICIPATION IN HIV PREVENTION RESEARCH TRIALS**

#### **Introduction**

The University of Rochester's Center for AIDS Research (CFAR) recognizes the need for community engagement, the establishment of rapport with local at-risk communities, and a holistic understanding of the experience of People Living with HIV/AIDS (PLWHA) in order to overcome barriers to participation in HIV prevention research trials, mitigate sociocultural stigma that may prevent high-risk individuals from receiving adequate HIV prevention and treatment services, and ensure the sustainability of educational and clinical interventions.<sup>1</sup>

The purpose of this study was to use the Promote Health Survey to identify social determinants of health that may facilitate or serve as barriers to participation in HIV prevention research trials run through the University of Rochester Center for AIDS Research. In theory, this study sought to identify differences and similarities in the social determinants of health between two groups: individuals at high risk for HIV infection who do intend to participate in clinical vaccine trials, and those who do not intend to participate in the trials.

Due to difficulties in obtaining IRB approval, recruitment for this project did not start until late August 2016, through the work of Lauryn Hemminger, a URSMD fourth-year student enrolled in the Community Health Improvement Course. Recruitment proved challenging and yielded only one study participant from Trillium Health, the study recruitment site.

---

<sup>1</sup>Alio et al., 2014

## **Discussion**

In reflecting on the challenges to this project, we have both identified the problems that arose, as well as laid the foundations for future directions in this field of research.

The obstacles that we faced in conducting this research can be classified as being on the level of the systems or the level of the potential research subject. Systems-level barriers include the inability to situate the study recruiter at a single, private location at Trillium on a regular schedule; lacking an incentive for study participants; inadequate orientation of the Trillium staff to the research study due to a shortage of time. Research subject-level barriers, which were identified by Trillium staff, include an ideological opposition to participation in research secondary to historical injustices such as the Tuskegee Syphilis studies; a misunderstanding about the non-invasive, minimal-risk nature of this study; and a hesitancy to identify with a stigmatized sexual orientation.

For a similar study to be successful in the future, the systems-level barriers could be addressed through more proactive scheduling of clinic offices for the purposes of having a private research setting, offering incentives to study participants, and allowing for a longer period of time for research staff to orient Trillium employees to the study in order for them to more adequately communicate its purpose to potential subjects.

In the case of this study, research subject-level barriers may prove more challenging to address. The troubling history of unethical medical research on societally marginalized populations and people of color indeed presents an ongoing barrier to facilitating the trust necessary for a research study to be conducted. We suggest that this challenge could be overcome by attempting a more personalized, qualitative method of data collection, such as individual ethnographic interviews between a research subject and the researcher. Additionally, this would allow the researcher to gain rapport, more directly answer questions about the research study, and ensure confidentiality of the answers provided in the survey.

## **Conclusion**

Given the research subject-level barriers to this project, we speculate that while this project did not identify barriers to participation in HIV prevention trials in the originally anticipated manner, it certainly illuminated the magnitude of the barriers to research participation by minority populations. Indeed, it seems possible that the very notion of "research" may be one that is not only foreign, but also one that carries connotations of prior injustices of medical research. Future directions for studying barriers to research participation – especially among those who may feel alienated and oppressed by the medical field – should include more open research methods, incentives for research participation, and additional efforts to address the identified obstacles to this project.

**Acknowledgements**

Thank you to Catherine Bunce and Drs. John Cullen and Michael Keefer for their mentorship throughout this research project. Thank you to the OME for their generous financial support of this project through the Clinical and Translational Summer Research Grant.

**Justin Williams**

Preceptor

Jonathan Mink

University of Rochester School of Medicine and Dentistry

Department of Neurology

### **DEVELOPING A STAGING SYSTEM FOR JUVENILE BATTEN DISEASE**

**BACKGROUND:** Neuronal ceroid lipofuscinoses (NCL) are a group of disorders characterized by neurodegeneration and intracellular accumulation of an auto-fluorescent lipopigment. NCL is the most common neurodegenerative disorder in children. The juvenile form is characterized by vision loss, seizures, epilepsy, dementia, behavioral difficulties, and motor impairment with the loss of vision usually being the first symptom to occur. The goal of this study is to develop a valid staging system for Juvenile Batten Disease (CLN3) to allow future researchers to create meaningful primary and secondary endpoints in clinical trials.

**METHODS:** Data from the CLN3 registry, which is a part of an ongoing natural history study, were analyzed using cross-sectional and longitudinal methods. The onset of symptoms characteristic of CLN3 were used to come up with 4 distinct clinical stages.

**RESULTS:** Significant differences were found between Stage 1 and Stage 2 [3.196 (95% CI:1.477-4.914);  $P < 0.0001$ ] and Stage 3 and Stage 4 [4.301(5% CI:2.829-5.773);  $P < 0.001$ ]. There was no significant difference between Stage 2 vs. Stage 3 [1.267(5% CI:0.1928-2.727);  $P = 0.1467$ ].

**CONCLUSIONS:** There were significant differences in ages between Stage 1 vs. Stage 2 and Stage 3 vs. Stage 4, indicating that patients progress through each stage of the disease as a function of age. The lack of difference between Stage 2 vs. Stage 3 indicates that the criteria for Stage 2 and Stage 3 could be combined or one of them could be eliminated.

**ACKNOWLEDGEMENT STATEMENT:** The authors thank the Office for Medical Education for providing funding; the parents and children for their participation in the natural history study, and the members of the University of Rochester Batten Center.

## Basic Science, Clinical & Translational Research

### William Wylie

Preceptor

Ryan Bell, MD

URMC

Department of Psychiatry

### **THE VA WAY: CLINICAL VIDEO TELEMEDICINE FROM HAWAII TO GUAM**

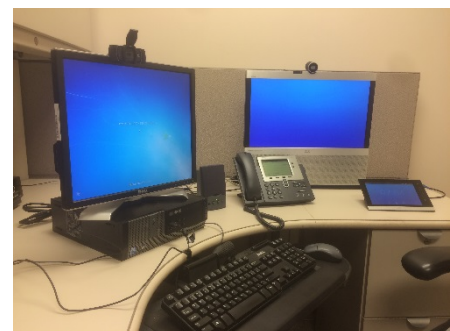
Telemedicine is often suggested as a cost effective way to increase access to health care. A variety of stakeholders—from providers at Strong Memorial Hospital to the nationally organized American Telemedicine Association—are working to integrate telemedicine into the medical system and define guidelines for its use. However, patchwork insurance coverage and concerns over safety have limited telemedicine's development in the civilian world. Non-inferiority trials and safety reviews along with pressure on insurance providers may be required before telemedicine can realize its potential. In contrast, the Veteran's Administration network has embraced telemedicine as a novel way to increase access to care. The benefits offered by telemedicine are particularly visible in the Pacific Islands VA, where providers may be separated from their patients by thousands of miles of ocean. This project examines the use of clinical video telemedicine (CVT) to connect mental health providers in Hawaii with veterans in Guam. The VA program uses cutting edge technology and is pushing the envelope for CVT, including offering treatment for veterans in their own homes. This program is accompanied by rigorous studies on the efficacy and safety of telemedicine and includes research on adjunct technologies for use in mental health care. As civilian healthcare networks consider the use of telemedicine, models like the Pacific Islands VA can provide perspective on what is possible, what should be possible, and how effective telemedicine can be.

*This project was made possible by funding from the Office of Medical Education at the University of Rochester.*

1. Agana Heights Outpatient Clinic, Guam, USA



2. Standard Clinical Video Telemedicine (CVT) setup, Honolulu, HI





## Community Health Research

**Abigail Clarkson-During, Melissa Lorenzo-Abbuhl, and Jennifer Rutz**

Preceptor

Adrienne Morgan, PhD

University of Rochester School of Medicine and Dentistry

Center for Advocacy, Community Health, Education, and Diversity

### **UR WELL: A GATEWAY TO HEALTHCARE FOR THE UNINSURED**

One of the biggest challenges currently facing medicine in America is the inability of countless citizens to access healthcare, especially primary medical care. This issue is largely attributed to the exorbitant costs of medical services and insurance. Although legislative efforts such as the Affordable Care Act have significantly increased the percentage of medically insured American residents, 23% of adults between the ages of 19 and 64 remain underinsured with deductibles and out-of-pocket fees that are too high relative to their incomes<sup>2</sup>. In Rochester, New York, the medically uninsured rate for residents under 65 is 12.1%, similar to the United States national average of 12.0%<sup>3</sup>.

UR Well Clinics provide medical care to Rochester's underserved community. UR Well encompasses three student-run clinic locations: St. Joseph's Neighborhood Center, St. Luke's Tabernacle Community Church, and Asbury First Methodist Church. These clinics provide physical exams, acute care, specialized care, and limited vaccinations and screenings to those who are either uninsured or underinsured.

Three student interns designed summer projects to better serve the UR Well community. The projects aimed to a) market St. Joseph's Neighborhood Center to Rochester's underserved population, b) manage the UR Well clinic sites, and 3) assess the relationship between access to healthcare and patients' health literacy.

### **Part I: Marketing St. Joseph's Neighborhood Center**

---

<sup>2</sup> The problem of underinsurance and how rising deductibles will make it worse: Findings from the Commonwealth Fund Biennial Health Insurance Survey, 2014. The Commonwealth Fund. May 2015. <<http://www.commonwealthfund.org/publications/issue-briefs/2015/may/problem-of-underinsurance>>

<sup>3</sup> QuickFacts: Rochester city, New York. US Census Bureau. 2015.  
<<http://www.census.gov/quickfacts/table/HEA775214/3663000,00>>

St. Joseph's Neighborhood Center (SJNC) is a nonprofit community clinic serving the uninsured and underinsured. It provides health services ranging from counseling and physicals to social work and adult education. SJNC is an ideal resource for individuals who cannot afford healthcare due to the high costs of insurance, deductibles, and/or co-pays and consequently are unable to effectively manage their chronic or acute health problems. Additionally, changes in health insurance have left many patients unsure of how to enroll in health insurance. SJNC connects these individuals with insurance for which they are eligible. As a result, the marketing aspect of the project contributed to expansion of SJNC's patient population and helped others to access health insurance.

After consulting with previous interns as well as clinic leadership, a list of public locations to solicit with marketing was constructed. Each location was called and, after providing a brief description of the center and its services, it was discussed whether the site would be interested and willing to display postcards in English and/or Spanish depending on their visiting population. Informational postcards were then ordered to match the numbers requested at the different locations. These informational postcards advertised the center with a short blurb about its services and a contact number. Each location was mapped strategically to facilitate the effective dissemination of SJNC advertising postcards; these postcards were continuously distributed at the various locations throughout the summer. Additional postcards were also delivered to various restaurants, bars, and shops throughout the city. As cards were dropped off, passersby were verbally informed about the clinic and its services. Many of the people encountered responded with tales of their respective difficulties with accessing healthcare.

## **Part II: UR Well Clinic Management**

UR Well clinics operate throughout the year, and thus require summertime staffing. The three student interns served as Administrative Coordinators at the various sites, enabling the clinics to continue to serve its patients during the summer when UR Well is significantly understaffed with student volunteers. The role consisted of patient intake and registration, PPD administrations, blood draws, and taking vitals. Interns also maintained the flow of the clinics, ensuring student Health Team efficiency, and assisting Clinic Coordinators with any additional miscellaneous tasks.

As part of this role, the various clinics were supported as the need arose. This included assisting the St. Joseph's daytime staff by addressing patient inquiries via phone as the center transitioned to new electronic medical software. Phone calls ranged from scheduling/rescheduling patients to confirming appointments, and required that the interns navigated the software. Furthermore, student interns received extensive training

on the new electric medical records system and were responsible for teaching UR Well student volunteers how to use the program.

### **Part III: Primary Care Access and Health Literacy**

The aim of this study was to determine if there is a significant relationship between patients' access to primary care providers and their health literacy. Health literacy, as defined by the Institute of Medicine, is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions<sup>4</sup>." Consequently, an individual's health literacy significantly affects his or her ability to effectively engage in self-care and chronic disease management. In this study, patients' health literacy was assessed by examining their understandings of the correlations between dietary and lifestyle habits and common medical conditions, specifically hypertension and diabetes. It was hypothesized that patients who lack steady access to a primary care provider will have a decreased awareness and understanding of lifestyle habits and preventive measures in regards to the said medical conditions. In this phase of the project, patients 18 years of age or older are being randomly pooled from the student-run UR Well Clinics at St. Joseph's Neighborhood Center, Asbury First Methodist Church, and St. Luke's Tabernacle Community Church and are administered pre-visit questionnaires to assess their health literacy. Preliminary results suggest that there is not a significant relationship between having a primary care physician and one's knowledge surrounding hypertension and diabetes. The average health literacy questionnaire score for participants with a primary care provider was 56% whereas it was 63% for those without a primary care provider. However, as the study continues and a larger, more balanced sample is obtained, it is anticipated that the predicted trends may be observed.

### **Acknowledgements:**

Thank you to the University of Rochester School of Medicine & Dentistry's Center for Advocacy, Community Health, Education and Diversity (CACHED) for its support.

---

<sup>4</sup> Quick guide to health literacy. US Department of Health and Human Services: Office of Disease Prevention and Health Promotion.

<<http://health.gov/communication/literacy/quickguide/factsbasic.htm>>

# Community Health Research

**Elaine Jaworski**

Preceptor  
Beverly Sirvent  
Finger Lakes Community Health

## **EFFECT OF HIV EDUCATION ON HIV TESTING IN NYS SPANISH SPEAKING MIGRANT POPULATION**

**Background:** Migrant Spanish speaking farm workers in the United States are at a high risk of Human Immunodeficiency Virus (HIV) given their unique living conditions. Research has shown that their low literacy, separation from family and partners, loneliness, drug use and lack of access to the health care due to time constraints, money, language barriers or health insurance all increase the risk of HIV among this population.<sup>2</sup> Migrant workers have increased rates of sex with multiple partners and paying for sex while separated from their families. Condom use is especially low amongst this population and misconceptions about HIV also lead to decreased testing.<sup>3</sup> One study in 2007 found that 33% of NYS farm workers believed that HIV only affects gay men and drug users, 13% believed HIV was curable and, 27% believed one should not have to be tested for HIV if they look healthy.<sup>3</sup>

**Purpose:** This research study will contribute to the generalizable knowledge of HIV testing rates among migrant farmers and effective methods to increase testing rates. Specifically the research compared rates of HIV testing among New York State migrant farm workers before and after an HIV educational program went into effect at the Finger Lakes Community Health outreach clinic.

**Methods:** This study was a retrospective chart review. A community health clinic in Upstate New York added an HIV educational briefing to care for patients in their mobile clinic. These patients were seen in their homes by the mobile clinic and a medical student provided a 10-15 minute presentation on HIV in Spanish, leaving room for questions and answers. The study looked at the acceptance of a free HIV rapid test before and after this educational briefing began. All male, Spanish-speaking patients were included in the study that were seen by the clinic in the month of October 2014 and October 2015. Forty-eight patients were seen before the educational briefing was added to the team and forty-four patients were seen after the briefing was added. The study looked primarily at whether or not patients accepted the HIV- rapid test.

**Results:** Of the 48 patients that did not receive educational briefing 16 accepted an HIV rapid test and of the 44 patients that did receive briefing, 19 accepted an HIV rapid test. There was no significant difference in acceptance of an HIV rapid test between the

control group and the education group with 42% accepting testing and 43% respectively. ( $t=1.372$ )

**Conclusion:** The educational briefing did not impact the level of HIV-rapid testing. Both groups had a low acceptance, which could be influenced by other factors. For instance, the patients do not have privacy during the visits, as the visits take place in their living rooms with their housemates. Also the educational briefing could effect their decision on a future visit, but the time frame may be too close between receiving education and making a decision on testing. Future studies should be done in order to find a more effective way to increase HIV-rapid testing among this at risk population.

**Acknowledgment Statement:** Funding for this research was provided by the Office for Medical Education Summer Community Research at the University of Rochester.

## References

1. Finger Lakes Community Health | Farmworker Services. (n.d.). Retrieved January 26, 2016, from <http://flchealth.org/>
2. Muñoz-Laboy, M., Hirsch, J. S., & Quispe-Lazaro, A. (2009). Loneliness as a Sexual Risk Factor for Male Mexican Migrant Workers. *American Journal of Public Health*, 99(5), 802–810. <http://doi.org/10.2105/AJPH.2007.122283>
3. NCFH. (2011, December). HIV/ AIDS Farmworker Factsheet. Retrieved January 26, 2016, from <http://www.ncfh.org/>

## Community Health Research

### **Jon-Michael Saenz and Kiera Hayes**

#### Preceptors

Dr. Adrienne Morgan

University of Rochester School of Medicine and Dentistry

Department of Medical Humanities and Bioethics

Dr. Erik Rueckmann

University of Rochester School of Medicine and Dentistry

Department of Emergency Medicine

### **INPATIENT HOMELESS RESPONSE TEAM: IMPLEMENTATION OF A NOVEL HOMELESS PATIENT ENGAGEMENT PROGRAM IN A MEDICAL SCHOOL SETTING**

The Homeless Response team was implemented with the goals of providing continuity of care for homeless patients and providing follow-up after discharge from Strong ED. This program has been particularly difficult to implement in this population due to difficulties finding patients and difficulties faced by the patient in accessing and taking advantage of resources. Patients were recruited from the Strong ED if they were identified as homeless and consented to be part of the program. Social workers then connected patients with the student volunteers. Alternatively, homeless individuals with high potential and motivation were identified during street rounds and enrolled independently. In the end, five homeless individuals were successfully enrolled and two were lost to follow up. Patients were expected to complete three surveys designed to evaluate their view of health care providers and their agency in assessing their health outcomes before and after their enrollment period. Student volunteers were encouraged to attend appointments and serve as a bridge between homeless individuals and health and social services, empowering patients to take charge of their health outcomes, and negotiating the complex web of social, personal, and medical needs.

Medical students faced a unique set of challenges in serving this role, many related to lack of knowledge about resources in the area. Students are unable to provide regular transportation to and from appointments or pharmacies. Established health care providers regularly denied access to health care information that might be useful in advocating for the patient or empowering them to take control of their health. Many times, students could not find the patient they were working with once the patient left the hospital. Despite these challenges, the program had relative success. As students gained more experience, they were better able to utilize resources in the city, including

services like MediCab. A RedCap database was created to better track outcomes and keep track of with the complex needs of our patient population as well as measure their scores on questionnaires. Through this we also tracked demographic information, contact with other agencies and providers, contacts with the patients, patient appointments and encounters, and time spent by students on these efforts. For patients with established contact, large steps forward were made in their care. One made progress in attaining insurance, evaluating a potential diagnosis of ALS, and moving into a more appropriate shelter. Another made immense progress toward housing and began to deal with a diagnosis of MS, attending appointments and opening himself up to treatment once he understood his disease satisfactorily. While our successes were small in number, they were large in significance. Despite all patients remaining a work in progress, patients have been mobilized ways that may not have happened without this intervention. Importantly, our experiences so far have demonstrated the potential success of a program of this nature. Important future directions include scaling up the number of teams, involving more volunteers to navigate the care of more patients, expanding education of the community about the program, and maintaining better accountability for patient contacts and outcomes. As the program grows and teams gain more experience, some of the barriers seen this summer will hopefully fade so that the teams can achieve improved outcomes for patients in these difficult situations.

## Community Health Research

**Jon-Michael Saenz and Kiera Hayes**

Preceptors

Dr. Adrienne Morgan

University of Rochester School of Medicine and Dentistry

Department of Medical Humanities and Bioethics

Dr. Erik Rueckmann

University of Rochester School of Medicine and Dentistry

Department of Emergency Medicine

### **UR STREET MEDICINE: STAKEHOLDER NEEDS ASSESSMENT AND PROGRAM EVALUATION AFTER TWO YEARS OF PROGRAM IMPLEMENTATION**

UR Street Medicine is a student run organization that has been providing health advice and support to Rochester's unsheltered and sheltered homeless since 2011. This program was designed after research on other outreach programs in the US and qualitative interviews with community outreach groups and homeless individuals in Rochester. However, since its inception, the program and the community opinions about the program have not been evaluated. The goal of this initiative was to assess community outreach groups', program volunteers, and homeless contacts' knowledge and attitudes about the UR Street Medicine program. A qualitative interview was conducted with a group of homeless individuals with whom the Street Medicine program has a consistent relationship. Online surveys were used to collect information from community outreach groups and program volunteers. Participants were identified from the Chronic Homeless Workgroup and with help from the leaders of that organization, and from the SRO office's list of students submitting volunteer hours last year.

The results showed that the program is still valued by the community, other community outreach teams, and program volunteers. Additionally, only a small proportion of the organizations surveyed worked with any medical organization, and 80% believed working with UR Street would benefit their programs. The majority of community and program volunteer respondents felt that some goals of the program were achieved well and that the outreach model was effective for providing medical services to homeless communities. Of the respondents, 85% felt the services provided by UR Street were needed by the population and mentioned acute medical care, exams, and preventative medicine as some of the most important characteristics. Homeless individuals felt that



the acute medical care was beneficial, but more greatly appreciated the administration of health and hygiene supplies. Program volunteers agreed that food and supplies provisions were highly effective, but they also believed the program succeeded at building relationships with people and making referrals. However, the research also identified many areas for improvement in the program itself and the program's relationship with other organizations. Community outreach respondents mainly mentioned trouble building connections with UR Street Medicine. From the program volunteers, there were a variety of concerns about poor education of student volunteers, poor physician involvement, and poorly clarified organization goals. The key complaint, however, was the need for an improved model for follow-up and continuity with patients. The respondents felt that the lack of information about who was seen, what was done, what was suggested, and whether the suggested follow-up was sought led to a major barrier to program efficacy. Finally, many students felt helpless and frustrated by the difficulties of working with this population, often feeling that progress was never made with patients and that their comments to other students to follow-up or get supplies for people were not addressed.

As a result of these surveys and interviews, the program has made several key changes. An organization email address has been rekindled and shared with local organizations. Additionally, a calendar of outreach groups' schedule and contact information is in development with the help of the Chronic Homeless Action Group. To address concerns with follow-up and continuity of care, a RedCap eRecord system was developed with mechanisms in place to find out when follow-up is scheduled and what guidance the patients were given in the past so that outreach teams can provide effective and well informed continuity of care. This system, and improved monitoring of available supplies and requested supplies will hopefully alleviate some of the concerns about program efficacy and feelings of helplessness. While there was doubt from program volunteers and some community outreach respondents about the importance of the program, the majority of respondents believed in the value of the program. All three groups identified areas for improvement that will help the organization be more effective in addressing the needs and the desires of the population, and hopefully this evaluation can serve as an example for continual improvement of the program.

**Hannah DeSelms and Andrew Wu**

Preceptors

Rajeev Ramchandran

University of Rochester Medical Center

Department of Ophthalmology

Sirisha Senthil

LV Prasad Eye Institute - Kallam Anji Reddy Campus

Department of Glaucoma Care

## **OUTCOMES OF TRABECULECTOMY AND GRAFT SURVIVAL IN EYES WITH GLAUCOMA FOLLOWING PENETRATING KERATOPLASTY/DESCMET'S STRIPPING ENDOTHELIAL KERATOPLASTY**

### **Introduction**

With a population exceeding 1 billion, India is home to over 18 million blind individuals. Of these cases, over 6.8 million are due to corneal disease, the second leading cause of blindness in the developing world. Corneal transplants, or keratoplasties, restore sight in patients who suffer from serious corneal conditions due to issues such as corneal scarring, thinning, and distortion. Of the different types of keratoplasties, penetrating keratoplasty (PK), the entire replacement of all layers of the cornea, is most commonly performed. Unfortunately, while developments in surgical techniques have significantly improved outcomes for patients undergoing keratoplasty procedures, corneal graft rejection continues to be a serious complication. Research on how to best conduct these transplants will help improve the length of viability of the grafts and by extension, the quality of life for patients in India and around the world.

The second leading cause of corneal graft rejection in patients undergoing keratoplasty is high intraocular pressure (IOP). Troublesomely, increases in IOP of at least 25 mmHG is a common sequelae of PK. Likewise, the probability of developing glaucoma rises in PK patients at rates and severities depending on the initial indication for the PK procedure, the development of glaucoma after PK, previous history of ocular trauma, and combined keratoplasty and cataract extraction surgery. Patients with a past history of glaucoma were found to be four times more likely to develop glaucoma compared to patients who never had glaucoma. These increases in IOP in patients undergoing PK appear to stem from the distortion of the anterior chamber angle caused by the sutures used in corneal grafting. Ultimately, this will disrupt the drainage of the eye's aqueous humor from the anterior chamber and cause angle closure glaucoma.

In contrast to PK, Descemet's Stripping Automated Endothelial Keratoplasty (DSAEK) involves transplantation of only the endothelial and stromal layers. While research on DSAEK is still limited, it is currently hypothesized that DSAEK will result in a lower incidence of post-keratoplasty glaucoma because its sutures are used in a more limited manner, resulting in less anterior chamber angle distortion than traditional PK. Our goal in this study is to compare how well IOP is managed in eyes that underwent PK with those that underwent DSAEK. Treatments often performed before or in conjunction with these surgeries include trabeculectomies, AGV implantation and MMC medications. Therefore, this study investigates the abilities of trabeculectomies to control intraocular pressure in post-PK patients who are on MMC and/or have AGV, against the intraocular pressures of post-DSAEK patients who are on MMC and/or have AGV. Additional variables measured are the graft survival percentages in PK and DSAEK groups.

### **Methods**

This a retrospective review of 100 patients who had glaucoma procedures and either PK or DSAEK procedures performed at LVPEI. Long term graft survival and IOP control were assessed by Kaplan-Meier survival analysis. Factors hypothesized to contribute to graft survival and IOP control were assessed for significance with a Cox (Proportional Hazards) Regression.

### **Results**

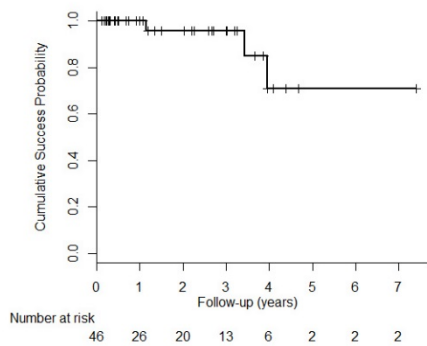
(The following are the initial results from DSEK patients only)

#### **Patient Demographics**

Data collected was from 46 DSEK procedures performed in 43 eyes with preexisting glaucoma during the study period from May 2008 to 2016 July. There were 13 female and 30 male subjects, 18 right eyes and 28 left eyes. 11 (24%) of the glaucoma surgeries performed were AGV (Ahmed glaucoma valve), 12 (26%) surgeries were trabeculectomies, and 23 (50%) surgeries were trabeculectomies with MMC. Four eyes underwent combined cataract surgery with the glaucoma surgery. 16 eyes had simultaneous surgery with DSEK (3 IOL exchange, 7 cataract extraction with PCIOL, one SFIOL, one AGV tube trimming, and one synechiolysis and tarsorrhaphy).

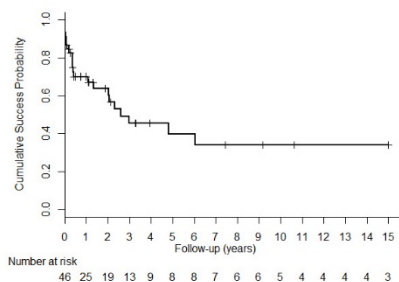
#### **Post Operative results**

Kaplan Meier survival analysis of our collected data shows success of all glaucoma procedures to be 67% at 1 year, 45% at 3 years, and 34% through a patient's last follow up (15 years)(Figure 1.). 3 additional eyes required repeat interventions post-op, 2 of which were needling and one of which was iridodilatorotomy.



**Figure 2. Kaplan–Meier survival curve demonstrating the probability of successful IOP control up to 7 years post-operatively.**

Kaplan Meier survival analysis of our collected data shows DSEK survival to be 100% at 1 year, 95% until 3 years, and 70% through a patient’s last follow up (Figure 2.) 3 eyes had graft failure, one of which had edematous graft prior to glaucoma surgery which worsened after 2 years. 3 additional eyes required repeat interventions post-op, 2 of which were rebubbling and one of which was resuturing.



**Figure 1. Kaplan–Meier survival curve demonstrating the probability of DSEK graft survival up to 15 years post-operatively.**

#### Experimental Parameters

Multiple variables were collected to analyze for impact on successful glaucoma procedure outcome including precorneal surgery IOP and AGM; DSEK graft size; and pre glaucoma surgery disc cupping, IOP, and AGM (Table 1.). A Cox regression performed on the preoperative parameters found that number of medications prior to corneal surgery ( $p=0.002$ ) and preoperative severity of optic disc damage (0.007) were significantly associated with failure of glaucoma surgery.

Preoperative parameters	Median (25 <sup>th</sup> percentile, 75 <sup>th</sup> percentile)	crude HR(95%CI)-univariate	crude P value-univariate	adjusted HR (95%CI)-multivariate	P-value-multivariate
Pre corneal surgery IOP	14 (11,17)	1.06 (0.96,1.16)	0.257	1.14 (0.97,1.33)	0.12
Pre corneal surgery AGM	0.5(0,2)	1.8 (1.26,2.58)*	0.001*	2.06 (1.3,3.26)*	0.002*
DSEK Graft_size	8(7.7,8)	1.01 (0.5,2.05)	0.97	0.6 (0.27,1.33)	0.206
Pre glaucoma surgery optic disc cupping	0.8(0.6,0.9)	0.15 (0.02,1.4)*	0.095*	0.01 (0,0.31)*	0.007*
Pre glaucoma surgery IOP	24.5(20,33)	1.01 (0.96,1.06)	0.649	1.0089 (0.9244,1.1011)	0.842
Pre glaucoma surgery AGM	3(2,4)	1.23 (0.86,1.76)	0.254	1.33 (0.81,2.17)	0.256

Table 1. HR - Hazard Ratio  
IOP- Intraocular Pressure  
AMG - number of anti-glaucoma medications  
\*Cox (Proportional Hazards) Regression

#### Discussion:

Conclusions about the comparative success of glaucoma surgery and graft survival in eyes post-DSAEK vs. post- PK cannot be made until analysis of PK data has been completed. We are hopeful to add to existing literature data from more patients at a longer follow up period than has previously been available. The relationship

demonstrated here between pre-glaucoma surgery optic disc cupping and surgical failure has not been reported previously for post-DSEK operations and could help to influence clinical decision in the future.

### References

1. Dandona, L., R. Dandona, and R. K. John. "Estimation of blindness in India from 2000 through 2020: implications for the blindness control policy." *The National medical journal of India* 14.6 (2000): 327-334.
2. Oliva, Matthew S., Tim Schottman, and Manoj Gulati. "Turning the tide of corneal blindness." *Indian journal of ophthalmology* 60.5 (2012): 423.
3. Banitt, M., and R. K. Lee. "Management of patients with combined glaucoma and corneal transplant surgery." *Eye* 23.10 (2009): 1972-1979.
4. Biswell, Roderick. "Chapter 6. Cornea." Vaughan & Asbury's General Ophthalmology, 18e. Eds. Paul Riordan-Eva, and Emmett T. Cunningham, Jr. New York, NY: McGraw-Hill, 2011. n. pag. AccessMedicine. Web. 29 Jan. 2016.  
<<http://accessmedicine.mhmedical.com/content.aspx?bookid=387&Sectionid=40229323>>
5. Salmon, John F. "Chapter 11. Glaucoma." Vaughan & Asbury's General Ophthalmology, 18e. Eds. Paul Riordan-Eva, and Emmett T. Cunningham, Jr. New York, NY: McGraw-Hill, 2011. n. pag. AccessMedicine. Web. 29 Jan. 2016.  
<<http://accessmedicine.mhmedical.com/content.aspx?bookid=387&Sectionid=40229328>>.
6. Wilkins, Mark, Andrea Indar, and Richard Wormald. "Intraoperative Mitomycin C for glaucoma surgery." The Cochrane Library (2005).
7. Minckler, Don, et al. "Aqueous shunts for glaucoma." The Cochrane Library (2006).

**Anisha Gundewar**

Preceptor

Nancy P. Chin, PhD, MPH

University of Rochester

Department of Public Health Services

**SOCIAL CAPITAL AND HEALTH:  
AN ETHNOGRAPHIC ANALYSIS OF WOMEN IN A MUMBAI SLUM**

**Acknowledgement Statement**

This research was supported by a 2014-2015 Fulbright-Nehru Student Research Fellowship (Grant Number: 2014/ST/30) and a 2016 URSMD Office of Medical Education International Summer Research Award.

**Introduction**

The purpose of this study is to understand the role of social capital in health among women in Kaula Bandar (KB), a non-notified slum on the eastern waterfront of Mumbai.

Current trends of rapid urbanization in the developing world are predicted to lead to an increase in the numbers of urban poor—a phenomenon termed the urbanization of poverty<sup>5</sup>. Increases in urban poverty are of particular concern in India, where approximately 93 million people are already living in slums<sup>4</sup>. The inadequate and unsafe living conditions in slums exacerbate deep health inequities among India's urban poor; the poorest quartiles in several Indian cities have higher under-five mortality rates, lower immunization rates, and worse antenatal care than the general urban population<sup>1</sup>.

In recent discourse on urbanization and poverty, social capital has gained popularity as a potential resource for buffering the effects of urban poverty on health<sup>3</sup>. Social capital is defined as a set of socio-cultural resources that consist of some aspect of social structure and facilitate certain actions of individuals within that social structure<sup>2</sup>. At the neighborhood level, it is hypothesized that social capital can improve health outcomes by increasing access to resources and social support during times of need<sup>3</sup>. In impoverished settings, where more tangible sources of financial capital are often lacking, leveraging social capital may be a way to improve community health<sup>2</sup>.

Quantitative studies have demonstrated the relationship between social capital and health in the Western context<sup>3</sup>. Few studies have emphasized qualitative approaches, and even fewer have explored other cultural contexts or adopted a gendered lens to evaluate connections between these variables.

## **Setting**

KB is a slum community located on the eastern waterfront of Mumbai, India. It was established by migrants from the Indian state of Tamil Nadu over 50 years ago<sup>7</sup> and now consists of approximately 2777 households<sup>6</sup>. Because KB is located on central rather than state government land, households in this community are denied access to basic necessities that are normally provided by the state, including water, electricity, sanitation, and education<sup>7</sup>. As a result, the residents of KB have poorer health outcomes and quality of life than those living in slums that receive municipal services<sup>7</sup>. The women of KB have lower rates of employment outside the home, lower literacy rates, and are more likely to have no education than their counterparts from other slums in India<sup>7</sup>. As an extremely marginalized community, KB provides a unique setting for exploring the relationship between social capital and health among urban poor women in India.

## **Community Partners**

This research was completed in collaboration with Partners in Urban Knowledge, Action, and Research (PUKAR), a Mumbai-based non-profit and research collective that has been working with Kaula Bandar since 2008.

## **Objectives**

1. Describe the context of health and illness in KB.
2. Infer – from the personal stories of community women – if, when, and how women in KB mobilize formal and informal social relationships to cope with health challenges.
3. Ascertain the relationship between social capital and health among women in KB.

## **Methods**

This was an ethnographic study; the primary methods were participant observation and 20 in-depth, semi-structured, individual interviews. Data was collected over a nine-month period between August 2014 – May 2015 and June 2016 – July 2016. The University of Rochester Institutional Review Board approved this study.

*Participant Observation:* Systematic observation of daily life in Kaula Bandar (KB), informal conversations with community members and professionals working in the community, and direct observation in health service delivery settings (local clinics, public and private hospitals). Data was recorded in field notes.

*Recruitment:* We used purposive and snowball sampling strategies. Eligible participants were current female residents of KB, over the age of 18. Demographics such as religious and cultural background, age, employment status, marital status, and duration of residency in KB were considered, to ensure that the final study sample was representative of the diversity among KB residents.

*Semi-Structured Interviews:* Participants were asked about their personal experiences with health and illness and the exchange of social support through both their informal and formal affiliations. Interviews ranged from 40-90 minutes and were



conducted in participants' homes. All interviews were conducted in Hindi, through a Hindi-English translator.

*Analysis:* Interviews and field notes were manually analyzed for recurring content, quotes, and themes.

### **Key Findings**

- Health challenges are a significant cause of concern and strain for families in KB.
- Accessing health services in Mumbai is a complicated process that involves navigating a network of local clinics and private and government hospitals.
- Women rely on small, trusted networks of family and neighbors for instrumental and emotional support when faced with health challenges.
- Within the local context of poverty and gender, these informal networks are shaped by variables such as employment status and housing stability.
- High social capital can help women respond effectively to illness within their households.

### **Discussion and Conclusions**

Conditions of daily life in Kaula Bandar (KB) place families at increased risk for poor health. As the primary caregivers within their households, women in the community often bear the greatest burden of coping with these health challenges. When a family member is sick, it is the daughter, mother, or wife who must navigate a vast and fragmented network of health services, overcoming barriers of transportation and cost, while also managing the daily responsibilities that keep her household running.

In times of need, many women in KB turn to small, informal social networks for situational instrumental and emotional support. Particular trust and reciprocity are high within these networks but do not often extend beyond an individual's network to the community as a whole. These tight social networks rarely link women to individuals with more power and resources. Thus, while bonding social capital is a crucial resource for women in KB, bridging and linking social capital are limited.

Within local contexts of poverty and gender, the family and neighbor relationships that make up these networks are largely influenced by variables such as employment status and housing stability. Therefore, these factors are also important determinants of social capital among women in the community.

### **References**

1. Agarwal, S. (2011). The state of urban health in India; comparing the poorest quartile to the rest of the urban population in selected states and cities. *Environment & Urbanization*, 23(1), 13-28. doi:10.1177/0956247811398589
2. Coleman, J. S. (1988). Social Capital in the Creation of Human Capital. *American Journal of Sociology*, 94, S95-S120. doi:10.1086/228943
3. Kawachi, Ichiro. (1999). Social Capital and Community Effects on Population and

Individual Health. *Annals of the New York Academy of Sciences*, 896(1), 120-130. doi: 10.1111/j.1749-6632.1999.tb08110.x

4. Ministry of housing and urban poverty alleviation. Government of India. Report of the committee on slum statistics/census. (2010).  
[http://nbo.nic.in/Images/PDF/REPORT\\_OF\\_SLUM\\_COMMITTEE.pdf](http://nbo.nic.in/Images/PDF/REPORT_OF_SLUM_COMMITTEE.pdf)
5. Ravallion, M. (2002). On the urbanization of poverty. *Journal of Development Economics*, 68(2), 435-442. doi:10.1016/S0304-3878(02)00021-4
6. Sawant K, Shitole S, Shitole T, Bloom D, Patil-Deshmukh A. "Lean on me — inequities of formal support systems during disasters for the most vulnerable residents in an unregistered slum" [Abstract OS1.4]. Oral Presentation. 10th International Conference on Urban Health. November 2-4; Belo Horizonte, Brazil.
7. Subbaraman, Ramnath, O'brien, Jennifer, Shitole, Tejal, Shitole, Shrutika, Sawant, Kiran, Bloom, David E, & Patil-Deshmukh, Anita. (2012). Off the map: the health and social implications of being a non-notified slum in India. *Environment and Urbanization*, 24(2), 643-663. doi: 10.1177/0956247812456356

**Alexandra Hutler, Daniel Underberg, Corrie Poelman, and Michelle Shankar**

Preceptors

Scott McNitt, MS

URMC

Heart Research Follow-Up Program

David Korones, MD

URMC

Department of Pediatrics

Richard Hodes, MD

American Jewish Joint Distribution Committee

### **FINGER-TO-KNEE DISTANCE AS A PREDICTOR OF LUNG FUNCTION IN PRE-OPERATIVE SPINE PATIENTS IN ETHIOPIA**

**Background:** Congenital deformities such as kyphosis and scoliosis are among the most common spinal disorders in Ethiopian children and adolescents.<sup>1</sup> Surgical intervention is the primary treatment for these deformities, but Ethiopia's limited medical resources make it necessary to prioritize who receives this care most urgently. Spinal deformities limit thoracic cage movement, impeding lung function.<sup>2</sup> Several studies suggest that height and arm span may be predictors of lung function in cases of spinal deformity, but these were only reliable in healthy, non-smoking subjects.<sup>3,4</sup> This study assesses the validity of using finger-to-knee (FTK) distance as a proxy for lung function in kyphoscoliotic patients. By validating this simple and effective way of predicting lung function, we provide valuable prognostic information in a setting that lacks formal diagnostic equipment.

**Methods:** Pre-operative spinal deformity patients underwent a series of measurements to calculate FTK distance and performed a pulmonary function test using a spirometer. The correlations between FTK distance and various lung function values were assessed.

**Results:** We enrolled a total of 62 patients between the ages of 8 and 39. We found a significant correlation between FTK values for each patient's right and left sides (correlation coefficient [CC] 0.75,  $p < 0.0001$ ). This justified our use of the minimum FTK value for each patient in the analysis with lung function values. We found there to be a significant correlation between the minimum FTK and both %-predicted forced vital

capacity (FVC) (CC 0.38,  $p=0.0035$ ) and %-predicted forced expiratory volume in 1 second (FEV1) (CC 0.45,  $p=0.0004$ ).

**Discussion:** Our data suggest that FTK is a reliable predictor of lung function in kyphoscoliotic patients. Since the only required material for FTK measurement is a tape measure, FTK is an ideal assessment of degree of lung function impairment in low resource settings. This is representative of the severity of spinal deformity, which is an objective measure that can be used to prioritize patients who most urgently require surgery.

**Acknowledgement Statement:** We would like to thank G&C Foods for their generous funding through their Summer Research Fellowship.

1. Konieczny, M.R. et al. "Epidemiology of adolescent idiopathic scoliosis" *Journal of Child Orthopaedics*. V.7(1); 2013 Feb.
2. Ran, H., W. Zhi Hong, and H. Jiang-Na. Scoliosis on Pulmonary Function. Rep. 1st ed. Vol. 33. N.p.: n.p., 2011. PubMed. Web. 4 Feb. 2015.4.2 (2010): 127-36.
3. Golshan, M., RO Crappo, B. Amra, RL Jensen, and R. Golshan. "Arm Span as an Independent Predictor of Pulmonary Function Parameters; Validation and Reference Values." *Respirology* 12.3 (2007): 361-66. Web.
4. Helms, P., SH Bain, and JO Warner. "Foot and Hand Length for Prediction of Vital Capacity in Scoliotic Children." *Spine (Phila Pa 1976)* 11.7 (1986): 746-48. Web.

**Joely Merriman**

## Preceptors

Maria Rosa Chitolina Schetinger, PhD

Center for Natural Science Federal University of Santa Maria

Department of Biochemistry and Molecular Biology

Daniela Bitencourt Rosa Leal, PhD

Lara Vargas Becker

Federal University of Santa Maria

Department of Microbiology and Parasitology

David Adler, MD

University of Rochester Medical Center

School of Medicine and Dentistry

**STUDY OF THE ENZYMATIC ACTIVITY OF E-NTPDase, E-ADENOSINE DEAMINASE AND ACETYLCHOLINESTERASE IN LYMPHOCYTES OF PATIENTS WITH SYSTEMIC LUPUS ERYTHEMATOSUS**

**Background:** SLE is a multisystem inflammatory autoimmune disease in which different organs can be affected showing a variety of clinical signs including skin, renal, gastrointestinal, pulmonary, vascular, cardiac, hematologic and neuropsychiatric symptoms. While its etiology is not fully understood, it is thought that a combination of genetic predisposition, environmental and hormonal factors favor the triggering of SLE, leading to the loss of immune response regulation, the development of autoantibodies, and a diminished capacity to functionally remove the immunocomplexes and debris of the inflammatory immune response causing injury at the cellular and tissue level. The disease possesses an unpredictable course, with periods of exacerbation and periods of remission. When unmanaged, symptoms can lead to physical incapacitation and premature death.

One potential method of better managing the disease would be to manage the inflammation. It is thought that an accumulation of nuclear material from cells that have undergone apoptosis in various tissues constitute a source of self-antigens. When presented with this cellular debris, T cells become activated, stimulating B cells to produce autoantibodies. Tissue damage in patients with SLE is the result immune complexes comprised of autoantibodies and self-antigens that are deposited within organs, leading

to a poorly-regulated inflammation response and consequently cellular damage. This study aims to shed light on the activities of molecules in the inflammatory response of SLE patients.

**ATP, IL cytokines:** ATP is involved in pro-inflammatory functions such as the stimulation and proliferation of lymphocytes and the release of cytokines. Various abnormalities have been related in patients with SLE in relation to circulating cytokines, including the decrease of interleukin 6 (IL-6), tumor necrosis factor alpha (TNF-alpha) and interferon (IFN-alpha). This project will measure levels of serum pro-inflammatory and anti-inflammatory cytokines in patients with SLE using cytometric bead array (CBA).

**ATP, E-NTDPase, E-ADA:** Adenosine acts as a self-limiting signal in the regulation of the immune system through calibration of immune cell activity and promoting a resolution to inflammation. Extracellular ATP levels are controlled by ectonucleotidases. E-NTDPase initiates the degradation of adenosine nucleotides while E-ADA converts the nucleoside adenosine to inosine. Both E-NTDPase and E-ADA levels of expression and activity will be measured in the serum of patients with SLE will be measured in accordance with Leal et al. (2005) and Guisti et al. (1984) respectively.

**ATP, P2X7 receptor:** The P2XL receptor is expressed on the plasma membrane of immune cells and is activated by adenosine and ATP. The level of P2X7 receptor activation has been found to mediate lymphocyte death or proliferation. The potential role of the P2X7 receptor in autoimmune diseases both organ-specific and systemic have been researched in mice with P2X7 deficiency. Research done by Elliott et. al in 2005 suggests that P2X7 is involved in the severity of rheumatoid arthritis, another autoimmune disease. The potential role of P2XL in SLE remains unknown. In this project, the levels of P2X7 expression in blood samples from patients with SLE will be quantified through real time PCR (RT-PCR). The sequencing of the primer will be obtained from the work done by Wang et al. in 2002.

**AChE:** AChE is expressed on both B and T lymphocytes and promotes the hydrolysis of ACh, choline and acetate; ACh promotes anti-inflammatory actions. Inhibitors of AChE reduce the proliferation of lymphocytes and the secretion of pro-inflammatory cytokines, and in-so-doing both attenuate inflammation and increase the concentration of ACh in the extracellular space. Accordingly, AChE is an important collaborator in the control of the inflammatory and immune response. AChE activity will be determined in accordance with Ellman et al. (1961) with some modifications.

Following denaturation and neutralization of serum samples, levels of ATP, ADP, AMP and adenosine will be identified by high efficiency liquid chromatography (CLAE) and quantified by comparing the area of peaks with patterns as discussed in Sherer et al., 2006.

Thirty [30] patients who have received a diagnosis of SLE and elected to participate in the project will have blood samples drawn at a scheduled appointment. Thirty [30] additional control study participants who match the SLE patients by age will likewise have blood samples drawn at individually scheduled times.

### **Preliminary results and conclusions as of 1 October 2016:**

Control N = 16. SLE Group N = 16.

1. TNF-alpha concentrations are diminished in SLE group, possibly in association with different stages of the disease
2. IL-10, IL-6 and IL-17A concentrations in SLE group are not significantly altered from control group individuals.
3. E-NTDPase activity in SLE group is not significantly different from control group.
4. CD73 expression is reduced in the SLE group, potentially favoring an inflammatory state through a diminished TH2 response.
5. E-ADA and AChE activity is not significantly different between the SLE and control groups.

### **Continuing the study forward:**

1. The researchers are continuing to enroll study participants with a goal totaling thirty [30] in each group.
2. The researchers will apply in vitro drug curves to adjust protein levels for individuals in SLE group currently medicated and report adjusted data alongside raw data.

### **Acknowledgement**

Funding for this project was made available by Federal University of Santa Maria and by the Center for Advocacy, Community Health, and Diversity at the University of Rochester School of Medicine and Dentistry.

## Stacy Salerno

Preceptors

Barclay Stewart

University of Washington

Department of Surgery

Teri Reynolds

World Health Organization

Department of Management of Non-commercial Diseases, Disability, Violence and Injury Prevention

## HEALTH CARE DELIVERY ASSESSMENT TOOLS FOR TRUAMA CARE: A CRITICAL REVIEW

**Background:** Assessment and targeted re-organization of emergency and trauma care can substantially reduce injury morbidity and mortality in low-and middle-income countries (LMICs). There are a number of existing health care system assessment tools relevant to trauma care delivery. We aimed to review the scope, site and components of available assessment tools relevant to the delivery of care for the injured.

**Materials and Methods:** The literature was systematically reviewed to identify health care delivery assessment tools relevant to trauma care. Additionally, we reviewed World Health Organization, NGO and professional society documents to identify relevant guidelines and tools. Tools were categorized by scope (e.g. trauma care, surgical care, emergency care), site (e.g. prehospital, hospital, outpatient, system), and components (e.g. infrastructure, equipment, procedures, training, quality improvement).

**Results:** Of the 92 records that were retrieved from a systematic search, 42 met inclusion criteria representing 6 tools. Fourteen additional tools were identified from other sources. The scope of the tools ranged from trauma system organization to emergency, surgical, and critical care, to rehabilitation. Facility-based emergency unit and operating theatre assessments were most common. Multiple tools for prehospital care were also identified. Assessments of overall trauma system organization were less common. Human resources, equipment, supplies, infrastructure, procedures, and training were the most commonly assessed components, although the content to be assessed varied greatly. Health information systems, governance and regulation, quality



improvement, research, maintenance, procurement and supply chain were poorly represented.

**Conclusion:** The majority of resulting documents identified tools addressing resourcing at the facility level. However, a few assessment tools address overall trauma system organization, governance, research, supply chain management, or quality improvement programs. The framework resulting from this study may be useful for groups planning to assess the delivery of care for the injured.

## Raphael Sweet

Preceptors

Sariat Noknoy, MD, MPH

Peace Corps Thailand

David Adler, MD

University of Rochester School of Medicine and Dentistry

Department of Emergency Medicine

## PERCEPTIONS AND PRACTICES OF MOTORBIKE HELMET USE AMONG THAI YOUTH IN CHIANG MAI, THAILAND

**Introduction:** Fatality rates from motorbike accidents in Thailand are the second highest in the world, underlining them as a major preventable public health and economic concern<sup>1</sup>. One reason for unsafe riding practices may be discord between perceptions of proper helmet use and the practice of wearing a helmet. The authors feel this information would contribute significantly to the development and implementation of sustainable helmet use and other safety interventions in the selected population.

**Methods:** Individuals between the ages of 18-25 were approached at public locations across Chiang Mai and received an information sheet detailing the study in either English or Thai. Once consented, participants completed a self-administered or interview-facilitated 23-question survey, also in either English or Thai. The survey consisted of three parts: Driving experience and history; Helmet safety perceptions/practices and exposure to helmet safety education; and Demographic information. The resulting data was stored and analyzed electronically using SurveyMonkey iOS software.

**Results:** A total of 100 persons were surveyed (62 males and 38 females). 99% of those surveyed regularly drove motorbikes and all participants rode on motorbikes as passengers. Of the drivers, 87% were taught to drive by family members and only 1% had participated in a formal driving course. 80% of drivers had been in at least one accident with 63% being involved in more than one. Of the total accidents, 79% resulted in physical injury to the driver and 67% resulted in that of the passenger. When surveyed about helmet use, 96% claimed to own a helmet with the majority (67%) owning only one helmet. Assessing perceptions of helmet use, 98% agreed or strongly agreed with the statement that wearing a helmet as the driver helps to avoid life-threatening injury. Further, 96% agreed that wearing a helmet as the passenger helps to avoid these injuries. When questioned about helmet use as a driver, 70% claimed to wear a helmet

often or always, while 30% cited wearing a helmet sometimes, occasionally or never. As a passenger, 36% stated that they wore a helmet often or always, while 64% selected sometimes, occasionally or never. The top five reasons for choosing not to wear a helmet as a passenger and as a driver were: 1.) My rides are over a short distance; a helmet therefore isn't necessary, 2.) I don't want to carry the helmet around with me, 3.) The helmet is uncomfortable, 4.) I don't like the way the helmet looks and 5.) There is no helmet available.

**Conclusion:** There is a clear gap between the proportion of participants who believe that wearing a helmet is important to prevent injury and the frequency with which they are wearing helmets. Popular reasons for choosing not to wear a helmet are similar for both passengers and drivers and reveal potential targets for educational interventions. Future research is warranted to assess the focus and practicality of these programs.

**Acknowledgement:** The researcher would like to acknowledge the Office of Medical Education at the University of Rochester School of Medicine and Dentistry for funding support.

<sup>1</sup> Sivak M, Schoettl B. Mortality from road crashes in 193 countries: a comparison with other leading causes of death. The University of Michigan Transportation Research Institute

**Kathleen Vaughan, Sarah Obudzinski, Naba Ali, Jeffrey Collins, and Andre Biscaye**

Adrienne Morgan, PhD

University of Rochester School of Medicine and Dentistry

Center for Advocacy, Community Health, Education, and Diversity

### **MAKING SEXUAL AND REPRODUCTIVE HEALTH (SRH) EDUCATION MORE SUSTAINABLE AND CULTURALLY SENSITIVE IN YANTALÓ, PERU: A MULTIGENERATIONAL APPROACH**

**Introduction:** Yantaló is a small, rural community in the San Martín province of Peru that lacks adequate infrastructure and healthcare. The Yantaló Peru Foundation was established to address the health care needs in this impoverished community. With high numbers of unplanned pregnancies amongst the adolescents in Yantaló, as well as a high rate of illiteracy and poverty, an important goal of the clinic is to improve sexual reproductive health (SRH) education in the region. Despite recent efforts to improve education and resources, access to SRH services remains a challenge in Yantaló. In our study, we sought to learn more about the SRH education, practices, and attitudes across four age groups. **Methods:** We administered surveys to 122 participants in four age groups: 13-17, 18-30, 31-49, and 50-79 years. Additionally, we interviewed 4 participants to get a more in depth perspective on SRH in Yantaló. Participants were obtained from the Yantaló School, at the Centro de Salud, by going door to door, and via the Yantaló Peru Foundation healthcare campaigns. **Results:** In regards to sexual education addressed in school, 48% of participants aged 50-79 never discussed SRH. However, 88% of participants aged 13-30 had discussed the subject in school at least once. The two most common sources of SRH education were parents and healthcare providers for participants aged 13-17 (27.5%, 20.4%, respectively). Participants aged 18-30 also indicated parents and healthcare providers as their main sources (27%, 50%, respectively). Participants aged 31-49 indicated friends, parents, and healthcare providers as their important sources (24% each). Participants aged 50-79 received their SRH education mostly from religious leaders and friends (20% each). 36.6% of study participants aged 13-17 never talked with their parents about SRH, 17% talked once, 19.5% talked 2-3 times, 26.8% talked 4 or more times. 67% of study participants aged 13-17 indicated they desired to receive SRH education from school. **Discussion:** Our results show that most participants aged 13-30 have received at least some form of SRH education in school (Figure 1). This result coincides with participants' desire to receive SRH education primarily through school (Figure 3). The source of SRH education has changed throughout age groups, with older participants indicating their main sources as

friends and religious leaders, compared with younger participants indicating their main sources as parents and healthcare providers (Figure 2). Thus, while most of the younger participants are receiving some form of sexual education in school, they still indicate their main source of SRH education as parents and healthcare providers. In conclusion, the current interventions in school could be improved and supplemented by parental and health care provider involvement. Finally, the interviews emphasized the desire to have parental involvement in their children's SRH education, and the importance of decreasing the stigma associated with sexual health. **Acknowledgement:** We would like to thank Dr. Luis Vasquez, Dr. Adrienne Morgan, and Dr. Hanna Mieszczanska for their support and guidance. In addition, we would also like to acknowledge the Office of Medical Education for their funding support of this project.

## Medical Humanities Research

### **Karishma Dara**

Preceptors

Bonnie Smith, MA

Deborah Napolitano

University of Rochester Medical Center

Strong Center for Developmental Disabilities Division of Neurodevelopmental and Behavioral Pediatrics

### **SKILL BUILDING RECOMMENDATIONS FOR TRANSITION-AGE YOUTH WITH INTELLECTUAL AND DEVELOPMENTAL DISABILITIES IN FOSTER CARE**

Youth with intellectual and developmental disabilities (IDD) in foster care represent a population with unique needs that should be met by both disabilities and child welfare services, but often are not. Because the child welfare system was never set up to support the specific needs of youth with IDD, this system failure may contribute to why youth with IDD have been shown to have poorer outcomes life outcomes (e.g., homelessness and unemployment) than their peers in foster care. Staff members reportedly do not feel trained to work with individuals with IDD effectively. Additionally, it has been our experience that the coordination between child welfare services and other systems, those specifically geared towards individuals with IDD, are poorly coordinated often due to state bureaucracies. As these youth leave the foster care system they are at much higher risk for not achieving self-sufficiency because their preparation has been disjointed and inadequate. The drive for research to improve transition outcomes for youth in foster care has rarely included youth with IDD. This highlights the great need for necessary improvements in service delivery and planning for successful transitions within this population. The purpose of our study was to provide a recommended set of skill domains for youth with IDD in foster care as they prepared for independence and adulthood. These skill domains could inform service providers of suggested areas they could work on with their youth. These recommendations are based on a review of current literature, transition curricula targeted for youth in foster care, transition curricula for youth with IDD, and a secondary analysis of data collected from seven forums across New York state in which stakeholders provided their opinion of the current transition needs of youth with IDD in foster care. We found that the developed list of skill domains clustered into the following overarching areas: (1) Health (e.g., coping, healthcare access) (2) Social Skills (e.g., building relationships) (3) Self Development (e.g., self-advocacy, problem-solving) and (4) Daily Life Skills (e.g., money management, employment). The 22 recommended skill domains span different areas of

independent living responsibilities. We argue that concrete life skills should not be the primary focus of preparation during a short period of transition, due to the needs of this population relating to exposure to adverse childhood events (ACE) and significant time spent in congregate care. Additionally, the transition period should extend over multiple years as an individual prepares to leave the system. In foster care, the focus may typically be on short-term permanency goals as opposed to necessary long-term transition planning. This study also revealed a potential role for skill-building in the resilience process for those who have experienced trauma. Most youth in foster care were removed from their families and may have been exposed to significantly adverse events such as abuse and neglect preceding the removal. The impact of this on an individual with IDD is relatively unknown, however intervention for youth with IDD is critical to help with successful transitioning to an adult. Further studies are needed to explore how skill-building can sustain resilience and successful transition to adulthood for this population. Finally, the results of our study indicate a critical need for further research to be conducted with youth with IDD in foster care to determine their priorities regarding learning and using these skills as adults.

**Acknowledgements:**

This project was made possible through a scholarship received for a research fellowship from the Haggerty-Friedman Psychosocial Fund for Behavioral and Developmental Pediatrics.

## Medical Humanities Research

### **Michelle Lawson**

Preceptor

Dr. Richard Demme

University of Rochester School of Medicine and Dentistry

Division of Medical Humanities and Bioethics

### **UNDERSTANDING OF BRAIN DEATH AMONG HEALTH CARE PROFESSIONALS IN THE SMH INTENSIVE CARE UNITS**

The goal of this study was to evaluate understanding of brain death among health care professionals who work in the Strong Memorial Hospital Intensive Care Units. The participants were 217 attendings, residents, nurses, medical students, and others who work in the ICUs at SMH. We asked the participants to take an online 21-question survey on brain death. The primary outcome of the study was the participant's score on a validated 5-question test of brain death understanding. We also looked at the participants' opinions about brain death and their knowledge of UPMC brain death policies. We found that there is a significant difference in brain death understanding among health care professionals at SMH. While 94.7% of attendings had expert understanding of brain death (defined as a score of 5 on the validated tool), 72.4% of nurses, 54.2% of medical students, 53.3% of other professions, and 47.6% of residents had expert understanding of brain death. Although most of the participants have been involved in brain death cases, a much smaller percentage have received formal training on brain death. This shows a lack of understanding and training on brain death among health care professionals at SMH.

Acknowledgement statement: I would like to thank the Office of Medical Education and CACHE for their generous research funding this summer.



## Medical Humanities Research

### **Jasmine Thai**

Preceptors

Amy Potter

University of Rochester School of Medicine and Dentistry

Department of Family Medicine

Lawrence Taw

David Geffen School of Medicine

Department of Medicine

University of California

Center for East-West Medicine

### **CLINICAL APPLICATIONS OF GINGER, PEPPERMINT, CITRUS PEEL, AND CHRYSANTHEMUM FLOWER**

Introduction:

Integrative medicine which is sometimes understood as a "movement back to the roots of medicine" holistically combines conventional medicine treatments with complementary and alternative treatments for which there is evidence of safety and effectiveness. Once deemed as irrelevant and scientifically unsupported, integrative medicine is slowly gaining favor in the United States. Although unprecedented technological and therapeutic advances have occurred in medicine in the past decade, public awareness of integrative medicine has grown. This trend is a a complex and striking phenomenon that perhaps brings to attention the importance of tradition and culture in the healthcare field that has been so strongly ignored in the past .

Surprisingly, even though integrative therapies seem to have garnered strong support from the public, there is little encouragement of these therapies from allopathically trained physicians. This is astonishing as much of integrative medicine is almost based entirely on prevention, a strategy that is advised by these same physicians. The rising amount of interest in integrative therapies makes it no longer acceptable for the medical community to remain ill informed and ignorant about integrative medicine.

This gap of knowledge in western allopathic physicians is sharply contrasted by the medical training of Chinese allopathic physicians who are dual-trained in western biomedical medicine and Chinese medicine. Perhaps this is why traditional Chinese medicine has slowly gained favor in the recent times. Still, not much literature is available on the clinical relevance of dietary herbs that are commonly recommended by

traditional Chinese medicine specialists.

Objective: To highlight the clinical applications of ginger (生薑), peppermint (薄荷), citrus peel (陳皮), and chrysanthemum flower (菊花), several herbs that are frequently suggested by traditional Chinese medicine specialists.

Method: A literature review and comparison of traditional Chinese medicine practices and current therapeutic uses.

Results and Conclusion:

Much of peer-reviewed literature appears to agree with many of the clinical applications that have been documented in traditional Chinese pharmacopoeia. Ginger is well studied for its antiemetic effect, may also have anti-inflammatory properties, and has been shown to be beneficial to slow the progression of atherosclerosis. Peppermint, as used in traditional Chinese medicine is now known to be beneficial for GI motility and is used extensively for preoperative preparation. Citrus peel can relieve delayed gastric emptying, has anti-inflammatory properties, and can also be used to prevent rapid progression of age-related demyelination. Chrysanthemum flower has antioxidant properties and has a protective effect on the brain, liver, kidney, and heart against oxidative damage. This shows that although much more research is needed, traditional medicine can no longer be ignored. Evidence and time has shown that integrative medicine is neither irrelevant or scientifically unsupported.

Acknowledgements: Special thanks to Dr. Lawrence Taw at the David Geffen School of Medicine, Dr. Amy Potter at the University of Rochester, and the Office of Medical Education at the University of Rochester for funding and support.

## References

1. Akdogan M, Brahim Kwlwnç IR, Oncu M, Karaoz E, Delibas N. Investigation of biochemical and histopathological effects of *Mentha piperita* L. and *Mentha spicata* L. on kidney tissue in rats. doi:10.1191/0960327103ht332oa.
2. Asou H, Sato N, Seiwa C, et al. Administration of chinpi, a component of the herbal medicine ninjin-youei-to, reverses age-induced demyelination. *Evidence-based Complement Altern Med*. 2011. doi:10.1093/ecam/neq001.
3. Bensky D, Clavey S, Stöger E. Chinese Herbal Medicine, Materia Medica. Seattle, Wash. : Eastland Press, c2004.; 2004.

4. Bliddal H, Rosetzsky A, Schlichting P, et al. A randomized, placebo-controlled, cross-over study of ginger extracts and Ibuprofen in osteoarthritis. *Osteoarthr Cartil.* 2000. doi:10.1053/joca.1999.0264.
5. Bone ME, Registrar S, Wilkinson DJ. Ginger root-a new antiemetic The effect of ginger root on postoperative nausea and vomiting after major gynaecological surgery. *Anaesthesia.* 1990;45:669-671.
6. Chaiyakunapruk N, Kitikannakorn N, Nathisuwan S, Leeprakobboon K, Leelasettagoon C. The efficacy of ginger for the prevention of postoperative nausea and vomiting: A meta-analysis. *Am J Obstet Gynecol.* 2006. doi:10.1016/j.ajog.2005.06.046.
7. Donna M. Selections from Current Literature Complementary therapies for nausea and vomiting in early pregnancy. *Fam Pract.* 2000;17(6):570-573.
8. Fuhrman B, Rosenblat M, Hayek T, Coleman R, Aviram M. Biochemical and Molecular Action of Nutrients Ginger Extract Consumption Reduces Plasma Cholesterol, Inhibits LDL Oxidation and Attenuates Development of Atherosclerosis in Atherosclerotic, Apolipoprotein E-Deficient Mice. *J Nutr.* 2000;130:1124-1131.
9. Grigoleit HG, Grigoleit P. Gastrointestinal clinical pharmacology of peppermint oil. *Phytomedicine.* 2005. doi:10.1016/j.phymed.2004.10.006.
10. Jiang H, Xia Q, Xu W, Zheng M. Chrysanthemum morifolium attenuated the reduction of contraction of isolated rat heart and cardiomyocytes induced by ischemia/reperfusion. *Pharmazie.* 2004.
11. Kiuchi F, Iwakami S, Shibuya M, Hanaka F, Sankawa U. Inhibition of Prostaglandin and Leukotriene Biosynthesis by Gingerols and Diarylheptanoids. *Chem Pharm Bull.* 1992;40(2):387-391.
12. Koretz RL, Rotblatt M. Complementary and Alternative Medicine in Gastroenterology: The Good, the Bad, and the Ugly. doi:10.1053/S1542-3565(04)00461-6.
13. Lan HC, Liang Y, Hsu HC, et al. Citrus reticulata peel improves patient tolerance of low-volume polyethylene glycol for colonoscopy preparation. *J Chinese Med Assoc.* 2012. doi:10.1016/j.jcma.2012.06.022.
14. Lasrado JA, Trinker D, Ceddia MA, Herrlinger KA. The safety of a dry spearmint extract in vitro and in vivo. *Regul Toxicol Pharmacol.* 2015. doi:10.1016/j.yrtph.2014.12.007.

15. Lii CK, Lei YP, Yao HT, et al. Chrysanthemum morifolium Ramat. reduces the oxidized LDL-induced expression of intercellular adhesion molecule-1 and E-selectin in human umbilical vein endothelial cells. *J Ethnopharmacol.* 2010. doi:10.1016/j.jep.2010.01.018.
16. Lin G-H, Lin L, Liang H-W, et al. Antioxidant Action of a Chrysanthemum morifolium Extract Protects Rat Brain Against Ischemia and Reperfusion Injury.
17. Lin LZ, Harnly JM. Identification of the phenolic components of chrysanthemum flower (Chrysanthemum morifolium Ramat). *Food Chem.* 2010. doi:10.1016/j.foodchem.2009.09.083.
18. Miller LG. Herbal Medicinals Selected Clinical Considerations Focusing on Known or Potential Drug-Herb Interactions. *Arch Intern Med.* 1998;158:2200-2211.
19. Miyazawa M, Hisama M. Antimutagenic Activity of Flavonoids from Chrysanthemum morifolium. *Biosci Biotechnol Biochem.* 2003;67(10):2091-2099.
20. Murakami A, Nakamura Y, Torikai K, et al. Inhibitory Effect of Citrus Nobiletin on Phorbol Ester-induced Skin Inflammation, Oxidative Stress, and Tumor Promotion in Mice 1. *CANCER Res.* 2000;60:5059-5066.
21. Neldner KH. Complementary and alternative medicine. *Dermatol Clin.* 2000;18(1):189-93, xi.
22. Pittler MH, Ernst E. Peppermint oil for irritable bowel syndrome: a critical review and metaanalysis. *Am J Gastroenterol.* 1998;93(7):1131-1135.
23. Singh Parmar H, Kar A. Medicinal Values of Fruit Peels from Citrus sinensis, Punica granatum, and Musa paradisiaca with Respect to Alterations in Tissue Lipid Peroxidation and Serum Concentration of Glucose, Insulin, and Thyroid Hormones. *J Med FOOD J Med Food.* 2008;11(2):376-381. doi:10.1089/jmf.2006.010.
24. Taw, MB. Integrative medicine, or not integrative medicine: that is the question. *J Intg Med.* 2015;13(6):320-352.
25. Tokunaga H, Seiwa C, Yoshioka N, et al. An extract of Chinpi, the dried peel of the citrus fruit unshiu, enhances axonal remyelination via promoting the proliferation of oligodendrocyte progenitor cells. *Evidence-based Complement Altern Med.* 2016. doi:10.1155/2016/8692698.
26. Urz??a A, Mendoza L. Antibacterial activity of fresh flower heads of Chrysanthemum coronarium. *Fitoterapia.* 2003. doi:10.1016/S0367-326X(03)00151-5.

27. Vutyavanich T, Kraissarin T, Ruangsri RA. Ginger for nausea and vomiting in pregnancy: Randomized, double-masked, placebo-controlled trial. *Obstet Gynecol*. 2001. doi:10.1016/S0029-7844(00)01228-X.
28. Wata EI, Otta HH, Oto MG. Hypolipidemic and Bifidogenic Potentials in the Dietary Fiber Prepared from Mikan (Japanese Mandarin Orange: Citrus unshiu ) Albedo. *J Nutr Sci Vitaminol*. 2012;58:175-180.
29. Wigler I, Grotto I, Caspi D, Yaron M. The effects of Zintona EC (a ginger extract) on symptomatic gonarthrosis. *Osteoarthritis Cartilage*. 2003. doi:10.1016/S1063-4584(03)00169-9.
30. Wu K-L, Rayner CK, Chuah S-K, et al. Effects of ginger on gastric emptying and motility in healthy humans. *Eur J Gastroenterol Hepatol Wolters Kluwer Heal Eur J Gastroenterol Hepatol*. 2008;20(20).
31. Wong J, Xu S, Karthikeyan OP. Selected papers from "International conference on Solid Waste - Knowledge Transfer for Sustainable Resource Management (ICSWHK2015)", 19-23 May 2015, Hong Kong Convention and Exhibition Centre, Hong Kong SAR. *Bioresour Technol*. 2016;217:1-2.
32. Yoshigai E, Machida T, Okuyama T, et al. Citrus nobilletin suppresses inducible nitric oxide synthase gene expression in interleukin-1 $\beta$ -treated hepatocytes. *Biochem Biophys Res Commun*. 2013. doi:10.1016/j.bbrc.2013.08.029.
33. Zhang W, Pritzker SE, Hui KK. Factors affecting definitions of and approaches to integrative medicine: A mixed methods study examining China's integrative medicine development. *Evidence-based Complement Altern Med*. 2015. doi:10.1155/2015/458765.

## Medical Humanities Research

**Deborah Yu**

Preceptor

Stephanie Clark, MD, PhD

University of Rochester School of Medicine and Dentistry

Department of Medical Humanities and Bioethics

### **REFURBISHING RELICS OF WESTERN MEDICINE: HISTORICAL ANATOMICAL MODELS ENLIVENING MODERN CADAVERIC DISSECTIONS**

With the development of new tech-savvy study aides for anatomy students, from “3D” anatomy apps to videos of dissections, the utility of first-hand cadaveric dissection is increasingly contested. Historically, the opportunities for carrying out dissections were few and far between often due to the limited availability of cadavers and their short “shelf life.” When dissections were performed, they were done by professional anatomists in anatomical theaters, and audience members were left to refer to and review from books and illustrations. Artists and anatomists cooperated to translate the three-dimensional experience into more readily accessible two-dimensional drawings. Continual efforts to better capture reality led to the production of anatomical models meant to allow medical students to engage the three-dimensionality of the human body even without recourse to dissection. Despite increasingly accurate representations, medical educators preserved the practice of dissection, eventually rendering such models obsolete. As a new student of anatomy and passionate about the humanities, I envisioned applying modern technology to reintroduce the forgotten three-dimensional forms of anatomical study and enrich contemporary experience of anatomy dissection. I travelled to three European countries to view collections of Susini’s and Towne’s wax models and Auzoux’s papier-mâché models: Italy’s University of Cagliari and La Specola, the Netherlands’ Museum Boerhaave, and the UK’s Whipple, Science, and Gordon museums. There, I researched the production of these eighteenth and nineteenth century objects and their roles in the past and present. As I observed and interacted with the figures, I wrote reflections making comparisons to first-year dissection and commenting on different dimensional representations of human form used in medical education. With permission, I took photographs and videos of the various models to be made digitally accessible for my peers. Overall, these particular models maintain an interactive three-dimensional component, while providing a less stylized depiction than many popular and relatively two-dimensional resources, as well as a more immediately post-mortem perspective than what is typically appreciated during cadaveric dissection; moreover, the context of these models serves as an alternative interdisciplinary

approach for engaging with anatomy. Considering the impressive history and technical quality of the aforementioned models, their study alongside dissection today may prove powerfully synergistic.

Acknowledgments: Funding was provided by the Division of Medical Humanities and Bioethics at the University of Rochester Medical Center. I would also like to thank Stephanie Brown Clark and Susan Daiss at the Division of Medical Humanities, Bart Grob at the Museum Boerhaave, Francesco Loy and Alessandro Riva at the University of Cagliari, Claudia Corti at La Specola, Katie Dabin at the Science Museum, Claire Wallace at the Whipple Museum, and William G. J. Edwards at the Gordon Museum for all of their guidance and encouragement.