



DMU   
Research  
Symposium



December 7, 2017  
Des Moines University  
3200 Grand Avenue  
Des Moines, IA

**Des Moines University's  
Research Vision is to be...**  
A cultivator of distinctive faculty and  
student researchers who discover  
and disseminate new knowledge.



## Welcome

---

Welcome to the eighth annual Des Moines University (DMU) Research Symposium! This year DMU is hosting almost 600 attendees and showcasing a record 74 interdisciplinary oral and poster presentations in biomedical science, movement science, public health, and education research in the health sciences. Presenters include students and residents from DMU and local undergraduate institutions as well as faculty and members of the medical and scientific community.

One of DMU's four vision statements is to become "a cultivator of distinctive faculty and student researchers who discover and disseminate new knowledge." There is no event that captures this vision better than our Symposium, where the entire DMU campus comes together to recognize the efforts of our students, faculty, and colleagues from the medical and scientific community.

For some of the students it is their first step into the more formal world of research and academia. This Symposium is more than an opportunity to present research. It is an opportunity to discuss their work, receive constructive feedback from affiliated faculty and fellow students, and to establish relationships between future peers in the health professions. We celebrate their success by demonstrating the critical role research plays in the advancement of health care, providing a forum for the collaboration of ideas, and fostering the production of new hypotheses. In addition to the student and resident awards for the best quality oral abstract and poster presentations, DMU will recognize faculty and clinicians who have demonstrated research and scholarly excellence over the past year. The awards will focus on researchers who have had an impact on advancing knowledge in science, health, education, wellness or other fields of study. I hope you're able to join us at the conclusion of the Symposium as we celebrate the countless hours of research conducted over the past year.

We are excited to welcome Dr. Melissa Burroughs Peña, MD, MS, as our keynote speaker. Dr. Burroughs Peña is an Assistant Professor of Medicine in the Division of Cardiology at the University of California-San Francisco. After graduating from Emory University with bachelor's degrees in anthropology and human biology, she attended Harvard Medical School, then completed internal medicine residency at UCSF and cardiology and advanced echocardiography fellowships at Duke University, where she also earned a master of science in global health. Some of Dr. Burroughs Peña early projects focused on HIV, since many global health efforts arose in the '80s and '90s in response to the AIDS epidemic. She frequently collaborates with researchers in HIV/AIDS and other infectious diseases, partnering with existing research sites to investigate cardiovascular disease. During her cardiology fellowship in Peru she helped conduct a study of cardiovascular risk factors in multiple settings, including rural, urban, high altitude and sea level environments. Dr. Burroughs Peña performed echocardiograms of nearly 200 participants, and learned about their barriers to care, such as difficulty accessing low-cost medicines. Dr. Burroughs Peña intends to apply her research towards shaping national and global health policy, mirroring the goals of many of our students at DMU

DMU is a leader in its research culture and environment. This Symposium demonstrates the strong research that is occurring on the DMU campus and in our community. While attending the oral presentations and viewing the posters, I hope you will reflect on how the discoveries we are making in research today will impact the scientific and medical community and the future of our patients.

Keep asking questions, enjoy the Symposium, and thank you for attending!

Jeffrey T. Gray, PhD

*Vice President for Research and Global Initiatives, Des Moines University*



## Agenda

Time	Session	Location
9 am	<b>Informal Poster Viewing</b>	<b>SEC First Floor</b> (Near the Bookstore)
12 pm	<b>Lunch</b>	
12:30 pm	<p><b>Keynote Address: Environmental Exposures and Cardiovascular Disease - A Challenge for Health Equity Worldwide</b></p> <p>Melissa Burroughs Peña, MD, MS <i>Assistant Professor of Medicine, Division of Cardiology, University of California, San Francisco</i></p> <ul style="list-style-type: none"> <li>Describe how environmental exposures are associated with cardiovascular disease</li> <li>Recognize the interrelatedness of cardiovascular disease epidemiology in the United States and throughout the Americas</li> </ul>	<b>SEC Auditorium</b>
1:30 pm	<b>Break</b>	
1:45 pm	<p><b>Poster Presentations</b></p> <p>Odd Numbered Posters Will Be Judged</p>	<b>SEC First Floor</b>
2:30 pm	<p><b>Poster Presentations</b></p> <p>Even Numbered Posters Will Be Judged</p>	
3:15 pm	<b>Break</b>	
3:30 pm	<p><b>Methylation Levels at Growth Differentiation Factor-15 Related CpG Sites are not Related to Death Risk from Cardiovascular Disease: National Heart, Lung, and Blood Institute Twin Study</b></p> <p><b>Pallavi Mukherji, DO'20</b>, Ming Leung, MS, Ruth Krasnow, Terry Reed, Wael El- Rifai, Jun Dai, PhD, MD, MSc</p>	<b>SEC Auditorium</b>
3:45 pm	<p><b>Regulation of Cardiac Adrenergic Response by the G Protein-Coupled Estrogen Receptor</b></p> <p><b>Victoria Whitcomb, MBS'21</b>, Vahe Matnishian, DPM'20, MBS'16, Eric Wauson, PhD, Sarah Clayton, PhD, Jennifer Giles, MA, Quang-Kim Tran, PhD, MD</p>	
4 pm	<p><b>Climate Change and Feet: Diabetic Foot Ulcers During Heat-Waves</b></p> <p><b>Rachel Egdorf, DPM'19</b>, Paul Schramm, Kathryn Conlon, Chelsea Austin, George Luber</p>	
4:15 pm	<p><b>Inhibition of Bone Morphogenic Protein 2-Inducible Kinase (BMP2K) is Protective to Cardiomyocytes Exposed to Simulated Ischemia</b></p> <p><b>Bryan J. Butel, DO'20</b>, Samuel I. Engman, Lee M. Graves, Eric M. Wauson, PhD</p>	
4:30 pm	<p><b>Awards Presentation</b></p> <p>Awards will be given to the winning presenting author(s) (students and residents only) with the best quality oral abstract and poster presentation. DMU will recognize faculty, clinicians, and staff who have demonstrated research and scholarly excellence over the past year.</p> <p>The awards will focus on researchers who have had an impact on advancing knowledge in science, health, education, wellness or other field of study. Faculty will also be recognized for their exceptional scholarly achievements, as evidenced by publications and/or other scholarly activities.</p>	
5 pm	<b>Adjourn</b>	



## Table of Contents

---

	<b>Page</b>
<b>Purpose</b> .....	1
<b>Mentored Student Research Program</b> .....	1
<b>Continuing Education Credit</b> .....	1
<b>Keynote Speaker</b> .....	2
<b>Keynote Presentation Slides</b> .....	3
<b>How to Read a Poster Abstract</b> .....	11
<b>Poster Abstracts</b> .....	12
<b>Oral Abstracts</b> .....	53
<b>Presenting Author Index</b> .....	55



## Purpose

---

The Research Symposium aims to recognize the research efforts of those at Des Moines University and in the surrounding medical and scientific community by providing a forum for the collaboration of ideas, the production of new hypotheses, and to demonstrate to the attendees the critical role that research plays in the advancement of health care.

## Mentored Student Research Program

---

The Mentored Student Research Program (MSRP) is a competitive program in which DMU students, as well as undergraduates, work alongside DMU faculty mentors on research projects in areas such as microbiology, pharmacology, physiology, biochemistry, public health, and physical therapy.

The majority of the program takes place over an eight-week period between Memorial Day and the end of July and includes additional learning opportunities such as research presentations from DMU faculty and a closing program that includes a guest speaker as well as oral and poster presentations by MSRP program participants.

MSRP participants are paid \$12 per hour and may work up to 40 hours per week during the summer, 20 hours per week during the school year, and up to 320 hours total during the program.

- **Information for DMU Students** - As part of the application, DMU students are required to submit a statement of support from their potential mentor specifically supporting their placement in the program.
- **Information for Undergraduate Students** - Selection of applicants is based on academic performance in the sciences, statement of career and academic goals, and a letter of recommendation from a biology or health science faculty member. Participants are paid \$12 per hour and no housing is provided.

The application period for the 2018 Mentored Student Research Program will be from December 7, 2017 to February 9, 2018. Late and incomplete applications will not be considered. For more information or to submit your application, visit the Office of Research website at <https://www.dmu.edu/research/student-research-opportunities/>.

## Continuing Education Credit

---

- **DO:** Des Moines University (DMU) is accredited by the American Osteopathic Association (AOA) to provide osteopathic continuing medical education for physicians. DMU designates this program for a maximum of 3.5 AOA Category 2-A credits and will report CME and specialty credits commensurate with the extent of the physician's participation in this activity.
- **DPM:** Des Moines University (DMU) is approved by the Council on Podiatric Medical Education as a provider of continuing education in podiatric medicine. DMU has approved this activity for a maximum of 3.5 continuing education contact hours.
- **MD:** This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Iowa Medical Society (IMS). Des Moines University (DMU) is accredited by the IMS to provide continuing medical education for physicians. DMU designates this live activity for 3.5 *AMA PRA Category 1 Credit(s)*<sup>™</sup>. Physicians should claim only the credit commensurate with the extent of their participation in the activity.
- **Nurse:** Des Moines University is Iowa Board of Nursing approved provider #112. This live activity has been reviewed and approved for 3.5 continuing education contact hour(s). No partial credit awarded.
- **Other Professionals:** This live activity is designated for 3.5 *AMA PRA Category 1 Credit(s)*<sup>™</sup>.



Educational grants were not accepted for this activity.



**Melissa Burroughs Peña, MD, MS**

Assistant Professor of Medicine, Division of Cardiology, University of California, San Francisco

- MS - Duke University, Global Health and Cardiovascular Medicine
- MD - Harvard Medical School

Cardiovascular disease is the leading killer in the US and throughout the Americas – and Dr. Melissa Burroughs Peña, a cardiologist with a keen interest in Latin America, is an emerging leader in improving heart health across the region. The widespread availability of fast food, growing rates of obesity and diabetes, and low access to preventive treatments such as statins contribute to the "perfect storm" of heart disease that is impacting Latin America, said Dr. Burroughs Peña. Unfortunately, it also hits patients at much younger ages than the US. "It's not just grandmothers having heart attacks, but people in their 30s, 40s and 50s who are supporting families and can no longer work," said Dr. Burroughs Peña. "It can sink a family very quickly, and is devastating to local communities and national economies."

*Relevant to the content of this CME activity, Dr. Burroughs Peña indicated she has no financial relationships with commercial interests to disclose.*

**UCSF Medical Center**

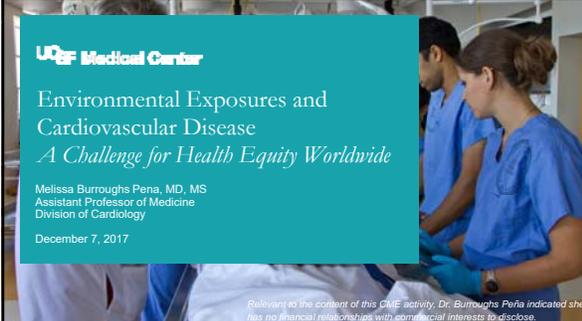
## Environmental Exposures and Cardiovascular Disease

*A Challenge for Health Equity Worldwide*

Melissa Burroughs Pena, MD, MS  
 Assistant Professor of Medicine  
 Division of Cardiology

December 7, 2017

Relevant to the content of this CME activity, Dr. Burroughs Pena indicated she has no financial relationships with commercial interests to disclose.

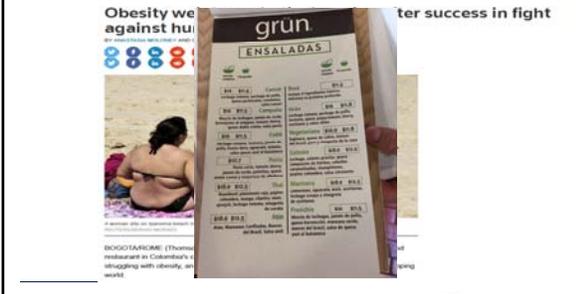


### Diversity in the Americas



**UCSF Medical Center**

Obesity we... against hu...  
 ter success in fight



**UCSF Medical Center**

### Inequality, Cardiovascular Disease, Environment



**UCSF Medical Center**

### Objective

- To describe how environmental exposures are associated with CVD
- To recognize the interrelatedness of cardiovascular disease epidemiology in the US and throughout the Americas

**UCSF Medical Center**

### Outline

- Ambient Air Pollution
- Biomass Fuel Smoke Air Pollution
- Heavy Metals

**UCSF Medical Center**



### State of the Air Report

- 46.2 million Americans live with harmful levels of air pollution
- 8.9 million Americans with CVD live in counties that received an F for a least one pollutant
- 22.9 million people living in poverty live in polluted counties

Stateoftheair.org

UCSF Medical Center

### 'Upwind' Midwest States Are a Pollution Nightmare, Easterners Say

Valeri Petrasov/Shutterstock.com

BY JACK FITZPATRICK  
March 9, 2016

UCSF Medical Center



#### Ambient Air Pollution

- Fossil fuel combustion

#### Household Air Pollution

- Biomass fuel combustion

by tuel

Brook RD et al (2010) Circulation, 121: 2331-78

UCSF Medical Center

### Short-term versus Long-term Exposure

#### Acute

#### Chronic

UCSF Medical Center

**The NEW ENGLAND  
JOURNAL of MEDICINE**

ESTABLISHED IN 1812      JUNE 29, 2017      VOL. 376 NO. 26

**Air Pollution and Mortality in the Medicare Population**

Qian Di, M.S., Yan Wang, M.S., Antonella Zanobetti, Ph.D., Yun Wang, Ph.D., Petros Koutrakis, Ph.D.,  
Christine Choirat, Ph.D., Francesca Dominici, Ph.D., and Joel D. Schwartz, Ph.D.

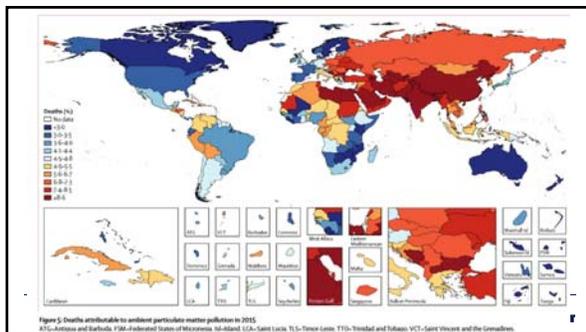
**UCSF Medical Center**

**Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015**

Aaron J. Cohen<sup>a</sup>, Michael Brauer<sup>a</sup>, Richard Burnett, H. Ross Anderson, Joseph Frostad, Kara Estep, Kalpana Balakrishnan, Bert Brunekreef, Lutz Dandona, Balaji Dandona, Valery Feigin, Greg Freedman, Bryan Hubbell, Amala Jishnu, Haidee Kan, Luke Knibbs, Yang Liu, Randall Martin, Lilla Morawska, Carole Pope, Huanwen Shen, Kurt Straif, Gavin Strödel, Matthew Thomas, Rita van Dongen, Aaron van Donkelaar, Theo Vos, Christopher J. Murray, Mohammad H. Forouzanfar

Cohen et al (2017) Lancet

**UCSF Medical Center**



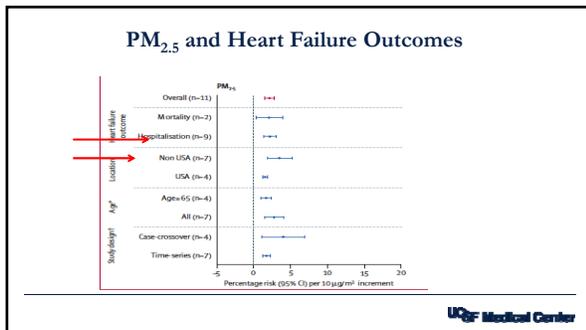
**Heart Failure Hospitalization and Death**

**Global association of air pollution and heart failure: a systematic review and meta-analysis**

Anoop S V Shah, Jeremy P Langrish, Harish Nair, David A Mulholland, Amanda L Hunter, Kim Donaldson, David F Newby, Nicholas I Mills

- Meta-analysis published in the Lancet
- 35 studies
- All high-income countries except one study from Brazil
- Temporal exposure to air pollution (including PM<sub>2.5</sub>) and heart failure hospitalizations and mortality

**UCSF Medical Center**



ORIGINAL ARTICLE

**Air Pollution, Cardiovascular Outcomes, and Social Disadvantage**

*The Multi-ethnic Study of Atherosclerosis*

Margaret T. Hicken<sup>a</sup>, Sara D. Adar<sup>b</sup>, Anjum Hajar<sup>b</sup>, Kiarri N. Kershaw<sup>c</sup>, D. Phuong Do<sup>d</sup>,  
R. Graham Barr<sup>e</sup>, Joel D. Kaufman<sup>b</sup>, and Ana V. Diez Roux<sup>f</sup>

**UCSF Medical Center**

**ORIGINAL ARTICLE**



**Traffic-related Air Pollution and the Right Ventricle**  
The Multi-ethnic Study of Atherosclerosis

Peter J. Leary<sup>1</sup>, Joel D. Kaufman<sup>1,2,3</sup>, R. Graham Barr<sup>4,5</sup>, David A. Bluemke<sup>6</sup>, Cynthia L. Curf<sup>7</sup>, Catherine L. Hough<sup>1</sup>, Joao A. Lima<sup>7,8</sup>, Adam A. Szpiro<sup>9</sup>, Victor C. Van Hee<sup>10</sup>, and Steven M. Kawut<sup>11</sup>

<sup>1</sup>Department of Medicine, <sup>2</sup>Department of Environmental and Occupational Health Services, <sup>3</sup>Department of Epidemiology, and <sup>4</sup>Department of Biostatistics, University of Washington, Seattle, Washington; <sup>5</sup>Department of Medicine and <sup>6</sup>Department of Epidemiology, Columbia University, New York, New York; <sup>7</sup>Radiology and Imaging Sciences, NIH Clinical Center, Bethesda, Maryland; <sup>8</sup>Department of Medicine and <sup>9</sup>Department of Radiology, Johns Hopkins Hospital, Baltimore, Maryland; <sup>10</sup>Occupational Medicine, Park Nicollet Medical Center, St. Louis Park, Minnesota; and <sup>11</sup>Department of Medicine, Department of Epidemiology, and Penn Cardiovascular Institute, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania

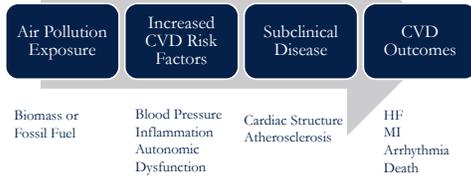
19

**Mechanisms of Disease**

- Systemic inflammation originating from particles trapped in the lung interstitium
- Translocation of ultrafine particles through the alveoli into the blood
- Oxidative stress, endothelial dysfunction
- Changes heart rate, vascular tone, heart rate variability, blood pressure

Mills (2009) Nature Clinical Practice: Cardiovascular Medicine 6(1): 36-44.

**Conceptualizing the Effect of Air Pollution on CVD**



**Ongoing Project- CRONICAS Lima Echo Study**



**Ongoing Project- AirSOL**



**Biomass Fuel Smoke Air Pollution**

## The Global Burden of Disease Attributed to Biomass Fuel Combustion

- 3<sup>rd</sup> most prevalent risk factor for death
- Affects 3 billion people world wide
- Methodology for determining the disease impact of household air pollution
  - Particulate matter concentration estimated
  - CVD affect of estimated particulate matter concentration from ambient air pollution studies
- Assumptions of the models

Smith et al Ann Rev Pub Health 2014; 35: 185-206  
Burnett et al. Environ Health Persp 2014; 122:397-403

UCSF Medical Center



UCSF Medical Center



UCSF Medical Center

## Biomass Fuel Exposure in US



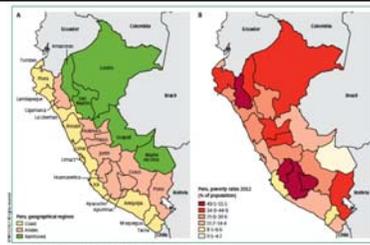
UCSF Medical Center

## Setting

- Puno, Peru
- Rural and Urban
- Low-income
- High-altitude



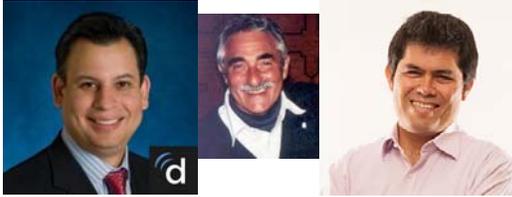
UCSF Medical Center



Pierros et al 2017, Lancet Oncol

UCSF Medical Center

## CRONICAS Study Group- Peru



UCSF Medical Center



UCSF Medical Center

## Necessary Elements for Success

- Trained personnel
- Community relationships
- Pre-existing cohorts
- Field offices
- Equipment
- Research administration (IRB & grants through AB PRISMA)
- Clinical and research training



UCSF Medical Center

## Variable Definitions

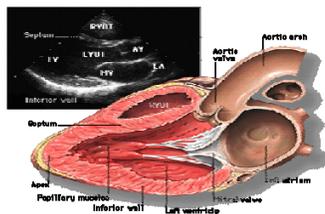
### Exposure

- Daily biomass fuel use for at least 6 months at any time in life
- Control group consists of nonusers (mostly urban)
- Limited by heterogeneity in the exposure group

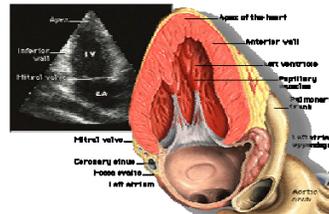
### Outcome

- Echocardiography
- Conventional measures of LV and RV size and function

UCSF Medical Center



UCSF Medical Center



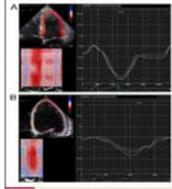
UCSF Medical Center

### Echo protocol

Measurement	Echo views	Echo Mode
LV mass (SWT, PWT)	PLX	2D
LVEDD	PLX	2D
LVESD	PLX	2D
LA diameter	PLX	2D
TR velocity	PLX, PSX, apical 4-chamber	Continuous wave Doppler
RVOT Time to Peak	PLX, PSX	Pulse wave Doppler
TAPSE	Apical 4-chamber	M mode
LA volume	Apical 4-chamber, Apical 2-chamber	2D
LA length	Apical 4-chamber	2D

**UCSF Medical Center**

### Speckle Tracking Myocardial Strain



- Speckle: formed by constructive and destructive interference
- Post-processing algorithm (varies by vendor)
- Tracked in systole and diastole
- Longitudinal (negative is normal)

Gorcsan III and Tanaka (2011) JACC

**UCSF Medical Center**

#### Table 1. Characteristics of Daily Biomass Fuel Users and Non-Users in Puno, Peru

Participant Characteristics	Biomass Fuel Non-Users (NoUsers)	Daily Biomass Fuel Users (NoUsers)	p-value
Age (mean)	58	60	0.201
Male	46 (43.0%)	33 (41.3%)	0.81
Body mass index, kg/m <sup>2</sup> (mean)	27.6	25.7	0.003
Heart rate, beats per minute (mean)	76.2	73.6	0.11
Hypertension	9 (8.6%)	5 (7.0%)	0.71
Diabetes	4 (3.9%)	10 (14.3%)	0.013
Pack-years of tobacco use (mean)	0.79	0.33	0.37
Hazardous alcohol use	15 (14.3%)	10 (14.1%)	0.97
Low physical activity	83 (79.8%)	50 (69.4%)	0.12
Less than primary education	9 (8.6%)	45 (62.5%)	<0.001
Lowest tertile of wealth index	19 (18.1%)	50 (70.4%)	<0.001

**UCSF Medical Center**

#### Table 2. Bivariate and Multivariable Linear Regression Analysis of Left Atrial and Ventricular Echocardiographic Parameters by Daily Biomass Fuel Use Adjusting for Age, Sex, Body Mass Index, Height, Physical Activity, Pack-years of Tobacco Use and Diabetes in Puno, Peru

Echocardiographic Parameter	Bivariate Model (95% CI)	p-value	Multivariable Model (95% CI)	p-value
Left ventricular internal diameter, diastolic, cm	0.12 (0.05, 0.20)	0.001	0.23 (0.05, 0.36)	0.004
Left ventricular internal diameter, systolic, cm	0.08 (-0.05, 0.20)	0.20	0.14 (0.05, 0.23)	0.02
Left ventricular ejection fraction, %	-0.09 (-0.20, 0.02)	0.20	-0.09 (-0.20, 0.02)	0.20
Left ventricular mass, g	0.96 (0.68, 1.24)	0.001	1.02 (0.68, 1.35)	0.001
Left atrial diameter, cm	0.03 (-0.13, 0.19)	0.70	0.18 (0.02, 0.33)	0.03
Left atrial area, 4-chamber, cm <sup>2</sup>	0.58 (-0.07, 0.94)	0.36	1.80 (0.57, 3.03)	0.004
Left atrial area, 2-chamber, cm <sup>2</sup>	0.46 (-0.06, 1.09)	0.32	1.67 (0.34, 3.01)	0.03
R <sup>2</sup> (adj)	0.08 (0.06, 0.11)		0.28 (0.10, 0.47)	0.03
Adjusted R <sup>2</sup> , cm <sup>2</sup>	-0.03 (-0.20, 0.14)	0.15	0.71 (0.04, 1.39)	0.04
Adjusted R <sup>2</sup> , cm <sup>3</sup>	-0.20 (-0.40, 0.00)	0.04	-0.20 (-0.40, 0.00)	0.07
Adjusted R <sup>2</sup> , cm <sup>3</sup>	-0.10 (-0.20, 0.00)	0.73	-0.10 (-0.20, 0.00)	0.74
Adjusted R <sup>2</sup> , cm <sup>3</sup>	1.00 (1.00, 1.00)	0.05	1.00 (1.00, 1.00)	0.06

**UCSF Medical Center**

Echocardiographic Parameters	Unadjusted Model (95% CI)	p-value	Multivariable Model (95% CI)	p-value
Left atrial strain, 2-chamber	-0.14 (3.29, -3.57)	0.93	0.52 (4.28, -3.25)	0.79
Left atrial strain, 4-chamber	0.54 (4.20, -3.12)	0.77	0.80 (4.60, -2.99)	0.68
Left ventricular strain, global longitudinal	0.47 (-0.17, 1.12)	0.15	0.47 (-0.25, 1.18)	0.20
Left ventricular strain, 4-chamber	0.04 (-0.85, 0.93)	0.93	0.09 (-0.89, 1.07)	0.865
Left ventricular strain, 3-chamber	-0.17 (-1.25, 0.91)	0.76	0.06 (-1.15, 1.26)	0.93
Left ventricular strain, 2-chamber	1.36 (0.51, 2.20)	0.002	1.25 (0.28, 2.22)	0.012

**UCSF Medical Center**





### Heavy Metals

- Lead
  - Peripheral arterial disease, stroke, coronary artery disease
- Arsenic (metalloid)
  - Peripheral arterial disease, stroke, coronary artery disease, cardiomyopathy
- Cadmium
  - Peripheral arterial disease, stroke, ischemic heart disease, acute coronary syndromes

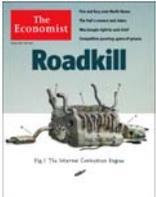
Burroughs Peña and Rollins (2017) *Cardiology Clinics*

### Occupational exposures in Echo-SOL

- Echo-SOL cohort, US Hispanics/Latinos, 2 cities, 1818 participants
- Self-reported environmental exposures at work
- Longest held job = current job
- Burning wood: LV diastolic volume (6.7 mL [1.6],  $p < 0.0001$ ), LV EF (-2.7% [0.6],  $p < 0.0001$ ), LV global longitudinal strain (GLS) (1.0% [0.3],  $p = 0.0009$ ), and decreased right ventricular (RV) fractional area change (-0.02  $\text{cm}^2$  [0.004],  $p < 0.001$ )
- Pesticides: average LV GLS (0.8% [0.2],  $p < 0.0001$ ).
- Metals: LV GLS in 2-chamber view (1.0% [0.5],  $p = 0.04$ ) and stroke volume (3.6 mL [1.6],  $p = 0.03$ )

### So what now?

- Mixtures of Exposures
- Climate Change
- Policy



### Acknowledgements

<h4>Funding</h4> <ul style="list-style-type: none"> <li>▪ VECD Consortium</li> <li>▪ Fogarty International Center</li> <li>▪ NHLBI</li> <li>▪ Hubert-Yeargan Center for Global Health</li> <li>▪ Duke Global Health Institute</li> <li>▪ Duke Clinical Research Institute</li> </ul>	<h4>Mentors and Advisors</h4> <ul style="list-style-type: none"> <li>▪ Eric Velazquez</li> <li>▪ William Checkley</li> <li>▪ Jaime Miranda</li> <li>▪ Carlos J. Rodriguez</li> <li>▪ Michelle A. Albert</li> </ul>
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

## How to Read a Poster Abstract

---

A common approach for evaluating posters involves considering the following factors in the technical, visual and presenter categories. This tool can be used when reviewing posters at this meeting and as a helpful guide for constructing your posters in the future.

Category	Notes
<b>Technical</b>	
Research topic clearly described with adequate introduction and a clear hypothesis.	
Good use of the space of the poster with sections on methods, results, and discussion as appropriate.	
Conclusion section which emphasizes the relevance of the research in the field of study.	
<b>Visual</b>	
Title, author(s), affiliations, and contact info included.	
Poster design logical and easy to follow with appropriate visuals (methods, results, etc.).	
Text easy to read, understand and free of errors.	
Graphics clearly contribute to the overall presentation.	
<b>Presenter</b>	
Able to communicate in-depth technical information in an easy-to-understand manner.	
Able to interpret the data properly, and clearly answer questions related to project.	
Recognize limitations of the project's procedures. Courteous and professional.	

Poster Abstracts

	Poster	Page
<b>Presenting Author(s) in Bold.</b>		
G = Graduate		
UG = Undergraduate		
HS = High School		
<b>BIOMEDICAL SCIENCE</b>		
Effectors of PKA Signaling Regulate Carbohydrate Storage and Starvation Survival in <i>C. albicans</i> and <i>S. cerevisiae</i> .....	1	18
<b>Zainab Tanveer</b> and Martin Schmidt, PhD	UG	
Novel Assays Reveal Opposing Effects of 17 $\beta$ -estradiol in the Presence and Absence of Ovarian Hormones on the Cardiac Network of Calmodulin-Binding Proteins .....	2	18
<b>Kyle Kaster, DO'20, John Patton, DO'20</b> , Briana Gebert-Oberle, MBS, DPM'20, Sarah Clayton, PhD, Jennifer Giles, MA, Quang-Kim Tran, PhD, MD	G	
Contribution of Tonic Peripheral Chemoreflex Activation to Renal HIF1 $\alpha$ /miR-155 Expression in Chronic Heart Failure .....	3	19
<b>Michael S. Weinfeld, DO'20</b> , Shaohan Deng, DO'20, Jennifer Giles, MA, Faithe Keomanivong, Harold D. Schultz, Rodrigo Del Rio, Noah J. Marcus, PhD	G	
Microglial Activation During Sensitization-Induced Hypertension in Rats .....	4	19
<b>Erika Roust, DO'20</b> and Sarah Clayton, PhD	G	
Glucocorticoid Signaling Regulates Activation of Hippocampal MKP-1 During Stress .....	5	20
<b>Tyler Folkerts, DO'20</b> , Cory Langreck, Dakota Nerland, MBS'21, Lori Semke, BS, Brad Lamb, Eric Wauson, PhD, Vanja Duric, PhD	G	
Effects of Stress on the Human Gut Microbiome.....	6	20
Joseph Johnson, DO'19, Devraux Boshard, DO'20, Aaron Shoskes, DO'18, Chunfa Jie, PhD, <b>LiLian Yuan, PhD</b>		
Synaptic Potentiation, Cytoskeletal Remodeling, and Rapid-Acting Antidepressant Actions .....	7	21
Zarin Rehman, <b>Amy Eisenberg, DO'20, MHA'22</b> , Nico Gotera, DO'20, MPH'21, Saiumamaheswari Saichellappa, MBS'20, Laura Herring, Lori Semke, BS, Eric Wauson, PhD, Lee Graves, Vanja Duric, PhD, LiLian Yuan, PhD	G	
Silencing of Calcineurin Homologous Protein-2 Restores the Regulation of pH by Growth Factors in Osteosarcoma Cells .....	8	21
<b>Adam P. Zobel, DO'20</b> , Silkman David, PA'19, Jordan J.R. Baker, DO'19, Elitsa Ananieva, PhD, Victor Babich, PhD, Francesca Di Sole, PhD	G	
Silencing of MAP Kinase Phosphatase 1 Blocks the Renal Inflammatory Response Induced by Chronic Stress.....	9	22
<b>Miranda M. Roland, DO'20</b> , Cory Langreck, Vanja Duric, PhD, Victor Babich, PhD, Francesca Di Sole, PhD	G	
Lactate, mTORC1, and AMPK are Differentially Impacted by Modulations in Leucine Uptake and Catabolism in Bone Sarcomas .....	10	22
<b>William Reiche, DO'20</b> , Shailer Martin, DPM'19 MBS'17, Michael Boyer, BS, Elitsa Ananieva, PhD	G	
Generation of Mice with a Loss of Function of the Cytosolic Branched Chain Aminotransferase 1 (BCAT1) in T cells: Breeding Strategy .....	11	23
<b>Sean McNitt, DO'20</b> , Michelle Brenner, DO'19, Michael Boyer, BS, Elitsa Ananieva, PhD	G	

	Poster	Page
Investigating the Effects of NALA (a Leucine Antagonist) and AICAR (an AMPK Activator) on the Energy Status and the Growth of Osteosarcoma Cells ..... <b>Alexander Schultz, DPM'21</b> , Shailer Martin, DPM'19 MBS'17, Michael Boyer, BS, Elitsa Ananieva, PhD	12 G	23
The Differential Effect of IL-39 on Two Different Prostate Cancer Cell Lines ..... <b>Theodore Stewart-Hester, DO'20</b> , Huaping Xiao, Ziwen Zhu, Qian Bai, Chase Redington, Jolie W. Chan, Zackary E. Hunzeker, Vivi A. Ding, Mark R. Wakefield, Yujiang Fang, PhD, MD	13 G	24
IL-29 Exhibits Anti-Tumor Effects on Pan-48 Pancreatic Cancer by Upregulation of P21 and Bax ..... <b>Dean Balabanov, DO'20</b> , Ziwen Zhu, Huaping Xiao, Zackary E. Hunzeker, Hannah M. Tonner, Vivi A. Ding, Mark R. Wakefield, Qian Bai, Theodore Stewart-Hester, DO'20, Jolie W. Chan, Yujiang Fang, PhD, MS	14 G	24
IL-39 Acts as a Friend to Pancreatic Cancer ..... <b>Alicia A. Manning, DO'20</b> , Ziwen Zhu, Huaping Xiao, Vivi A. Ding, Theodore Stewart-Hester, DO'20, Qian Bai, Joseph Schmidt, Nick Caruso, Jacob Dunlap, Benjamin G. Tlapec, Aldo Dominguez, Mark R. Wakefield, Yujiang Fang, PhD, MD	15 G	25
Pineapple Extract Has Little Effect on the Growth of Lung Cancer Cells Although It Inhibits Growth of Normal Bronchial Epithelials ..... <b>Andrew Ames, DO'20</b> , Huaping Xiao, Ziwen Zhu, Noah J. England, Aldo Dominguez, Mark R. Wakefield, Qian Bai, Vivi A. Ding, Ted W. Stewart-Hester, DO'20, Yujiang Fang, PhD, MD	16 G	25
FcγR-Mediated Signaling is Regulated by C1q..... <b>Anna Jokinen</b> , E.A. Willmann, Vesna Pandurovic, BS, Rachel Anderson, MS, Suzanne Bohlsom, PhD	17 UG	26
Herpes Simplex Virus 1 Inhibition by Co-Administration of Acyclovir and the Telomerase Inhibitor MST-312..... <b>Neil Febel</b> , Prajakta Pradhan, MS, Marie Nguyen, PhD	18 UG	26
Extracting 3D Surface Data from the Endocasts of Fossil Canids and Felids ..... Ian Glidden, <b>Kathleen Bitterman, BS</b> , Paul R. Manger, Rachel H. Dunn, PhD, Muhammad A. Spocter, PhD	19	26
A Preliminary MRI and DTI Brain Atlas of the Siberian Tiger ( <i>Panthera tigris altaica</i> ) ..... <b>Victoria Knauf, DPM'19</b> , June E. Olds, Rachel Derscheid, Johnny C. Ng, Victoria X. Wang, Cheuk Tang, Bridget Wicinski, Patrick R. Hof, Chet C. Sherwood, Paul R. Manger, Muhammad A. Spocter, PhD	20 G	27
The Brain of the African Painted Dog ( <i>Lycaon pictus</i> ): MRI Atlas, Diffusion Tensor Imaging and Quantitative Volumetrics..... <b>Jonathan Tenley, DPM'19, MSA'17</b> , Samson Chengetanai, Jennifer Niederlander, Megan Duncan, Johnny C. Ng, Victoria X. Wang, Cheuk Tang, Bridget Wicinski, Patrick R. Hof, Paul R. Manger, Muhammad A. Spocter, PhD	21 G	27
The Gyrification Index of the Domestic Dog..... Victoria Knauf, DPM'19, <b>Tuan Truong</b> , Geoffrey Aguirre, Ritobrato Datta, Johnny Ng, Victoria X. Wang, Cheuk Tang, Bridget Wicinski, Patrick R. Hof, Chet C. Sherwood, Paul R. Manger, Muhammad A. Spocter, PhD	22 HS	28
What Can the Scapholunar Bone Tell Us About the Locomotion and Habitat of Extinct Carnivores? ..... <b>Natalie Mironov, DO'20</b> , Julie Meachen, PhD, Rachel Dunn, PhD, Candice Cooper, Joshua Lemert, DO'20, MSA'22	23 G	28

	Poster	Page
Quantification of Optic Nerve and Optic Canal Size ..... <b>Kathryn Schwalbe, DO'18</b> , Lauren Butaric, PhD, Todd Yokley, PhD	24 G	29
Progress Towards the Natural Product Synthesis of (S)-1-oxocurcaphenol (A Possible Anti-Cancer Agent) ..... <b>Corey S. Keenan, DO'21</b> and S. Shaun Murphree, PhD	25 G	29
Statin Binding Affinity to CYP2D6 Reduced-Function Alleles in Three Populations ..... <b>Noori Al Kadhim, DO'21</b> and Haizhen Zhong, PhD	26 G	29
Olfactory Sensory Neurons are More Active in Fmr1 Knock-Out Mice Than in Wild-Type Mice ..... <b>Sakshi Kaul, DO'21</b> , Lauren Kirk, Priscilla Ajilore, Katherine A. Shepard, Michael R. Akins	27 G	30
Activation of Novel Prodrugs to Combat Herpes Virus Infections ..... <b>Anna Burns</b> , Marc Busch, PhD, Brian Gentry, PhD	28 G	30
Fabrication of 3D Printed Suppositories for Individualized Drug Delivery: Evaluating Potential Polymers and Software..... <b>Andre Do</b> and Abebe Mengesha, PhD	29 UG	31
Identifying Substandard Medications in Developing Nations..... <b>Esad Omanovic</b> , Jordan Donels, Justin Trier, Alli Thomsen, Julia Dollen, Austin Miller, Nejla Memic, Corbin Zea	30 UG	31
Renal Cell Carcinoma: A Rare Case of Ureteral Metastasis and a False Negative Biopsy ..... <b>Alexander Zhu, DO'19</b> , Siwei Dong, DO'19, Matthew Fabiszak, DO	31 G	32
Large Pericardial Effusion Mimicking TB Pericarditis ..... <b>Nikhut Siddique, DO'18</b>	32 G	32
Assessing Male Pelvic Floor Dysfunction Using Ultrasound Imaging: A Literature Review ..... <b>Kathryn Estes, DO'20</b> , Kari Smith, DPT, BFB-PMD, Catherine Stevermer, PT, PhD, GCS	33 G	33
<b>EDUCATION</b>		
Analysis of Publications and Funding for a Small Health Sciences University Over a Three-Year Period ..... <b>Kieran Severa</b> , Mollie Lyon, Jeffrey Gray, PhD	34 UG	33
Effect of Participation on a Short Term Medical Service Trip on Cultural Competence in Health Care Professional Students..... <b>Michelle Mages</b> , John Rovers, Michael Andreski, Jeffrey Gray, PhD	35 G	34
Faculty Perceptions of a Piloted Curriculum Mapping Experience..... <b>John Kim, DO'20</b> and Leslie Wimsatt, PhD	36 G	34
Practice Makes Perfect: What Does It Take to Perform Better in Medical Pharmacology at DMU? ..... <b>Matt Henry, PhD</b>	37	35
Effectiveness of Two Different American Heart Association Basic Life Support Educational Designs on Learner's Foundational Basic Life Support Skills Quality ..... <b>Shelley L. Oren, MS</b> , Gavin Gardner, MA.Ed., Gregory Kolbinger, MPAS, PA-C	38	35

	Poster	Page
Using Science Kits to Bring The Fun Back Into High School Anatomy and Physiology Class .....	39	36
<b>Sandy Le</b> , Tiffany LeMaster, Kacia Cain, Kathleen Bitterman, BS, Muhammad A. Spocter, PhD	HS	
Analysis on Vision Screenings of Daycare and Elementary Children in the Des Moines Metropolitan Area with Waukee APEX and Prevent Blindness Iowa .....	40	36
<b>Kaitlyn Harris</b> , Holly Showalter, PhD, Jeanne Burmeister	HS	
<b>PUBLIC HEALTH</b>		
Zika Virus Knowledge, Education, and Contraceptive Use Among Rural Dominican Republic Communities.....	41	37
<b>Shant Adamian, DO'19</b> , Sarah Andres, DO'19, <b>Brooke Bachelor, DO'19</b> , Elizabeth Baker, PhD, <b>Fiona Hodges, DO'20</b> , <b>Tricia Mitra, DO'19</b> , Rebecca Shaw, MD	G	
Climate Change and Preparedness for Future Pandemics, Case Study: Zika Virus.....	42	37
<b>Shant Adamian, DO'19</b> and John Balbus, MD, MPH	G	
Strengthening Health Care Infrastructure Post USSR: A Comparative Analysis of Post-Soviet State .....	43	38
<b>Nelli Ghazaryan, DO'21</b> , Pierre Vigilance, MD, MPH, Simon Geletta, PhD	G	
Changes in the Ambulatory Care Visit Patterns Among Iowa Hospitals.....	45	39
<b>Alexandra Halbach, DO'20</b> and Simon Geletta, PhD	G	
Assessing the Use of the IPOST at Admission to the Emergency Department.....	46	39
<b>Lindsey Harrison, DO'20</b> , Emilie O'Connor, DO'20, MHA'23, Catherine Hackett Renner, PhD, Nicholas Kluesner, MD	G	
Evaluation of the Emergency Department Fast Track to Reduce Patient Length of Stay .	47	40
<b>Sophia Hackman, DO'19, MPH'21</b> , J. Mark Wise, Clint Hawthorne, MD, Natalie Chadwick, PA-C	G	
Contextual Care in Health Outcomes: A Systematic Review of Reviews .....	48	40
<b>Satvika Mikkilineni, DO'20</b> and Jeritt Tucker, PhD	G	
Quality Measurement by Medicare Physicians in Urban and Rural Areas in 2016 .....	49	41
<b>Tami Swenson, PhD</b>		
Interventional Pain Procedure Trends by Medicare Providers.....	50	41
<b>Tami Swenson, PhD</b>		
<b>MOVEMENT SCIENCE</b>		
Effect of Tai Chi on Stiff Knee Gait Post Total Knee Arthroplasty .....	51	42
<b>Kristina A. Sturdevant</b> , Chaston R. Pola, DPT'19, Kathy L. Mercuris, PT, DHS	UG	
Neck Pain: A Feature of Sinus Headaches .....	52	42
<b>Laura Burton, DPT'18</b> and Shannon Petersen, PT, DScPT, OCS, FAAOMPT, COMT	G	
Cervical Pain Threshold and Quality of Life Impairments in Subjects with Sinus Headaches .....	53	43
<b>Daniel Larson, DPT'18</b> , Laura Burton, DPT'18, Carrie Nelson, DPT'19, Shannon Petersen, PT, DScPT, OCS, FAAOMPT, COMT	G	

	Poster	Page
Biomechanical Indicators Related to Pronation: A Bottom-up Perspective of Running Gait Analysis .....	54	43
<b>Donald T. McDonald, DPM'20</b> , Carolyn F. Weber, DPT'19, Shane McClinton, PT, PhD, OCS, FAAOMPT	G	
Predictors of Response to Treatment for Plantar Heel Pain.....	55	44
<b>Donald T. McDonald, DPM'20</b> and Shane McClinton, PT, PhD, OCS, FAAOMPT	G	
A Top-Down Perspective on Running: Relationships Between Trunk and Arm Kinematics and Established Risk Factors for Lower Extremity Injuries.....	56	44
Carolyn F. Weber, DPT'19, Donald T. McDonald, DPM'20, <b>Shane McClinton, PT, PhD, OCS, FAAOMPT</b>		
The Figure-of-8 Walk Test: A Clinical Measure of Motor Skill in Walking for Persons with Parkinsons Disease.....	57	45
<b>Taylor Woods, DPT'20</b> , Amanda Brandt, Alex Krajek, Ann Smiley-Oyen, Kristin A. Lowry, PhD, Jessie VanSwearingen	G	
Cues Matter: The Effect of Cueing on Gait Automaticity in Young Adults.....	58	45
<b>Noel Murray, DPT'18</b> , Alex Krajek, Taylor Woods, DPT'20, Corrin Russell, DPT'19, Kristin A. Lowry, PhD	G	
Active and Passive Foot Arch Support Mechanisms Under Various Weight-Bearing Conditions .....	59	46
<b>Alena Kelly, DPM'20</b> , Kiera Bengel, DPM'20, Robert Yoho, DPM, David Stapleton, BS, Vassilios Vardaxis, PhD	G	
Identification of the Scapular Plane for Arm Elevation in Non-Symptomatic Adults.....	60	46
<b>Jeff Mann, DO'20</b> , Jordan Estes, DO'20, David Stapleton, BS, Traci Bush, DPT, OTR/L, DHS, Vassilios Vardaxis, PhD	G	
Effect of Load and Motion Direction on Shoulder Scapulohumeral Rhythm (SHR) .....	61	47
<b>Matthew Gibbs, DO'20</b> , J. Thomas Lowe, DO'20, Jacob Ahles, DO'20, MSA'20, Jase Schossow, DO'20, MSA'20, David Stapleton, BS, Traci Bush, DPT, OTR/L, DHS, Vassilios Vardaxis, PhD	G	
An Anatomical Study of Three-Dimensional Frontal Plane Rotation in Hallux Abducto Valgus Deformity with Clinical Applications to Surgery .....	62	47
<b>Stefany Beraldo, DPM'20, John Walsh, DO'20</b> , Paul Dayton, DPM, MS, FACFAS	G	
The Influence of Sexual Dimorphism on Outcomes After Primary Hip Arthroscopic Surgery in the Presence of Borderline Dysplasia: A Match-Controlled Study with a Minimum 2-Year Follow-Up .....	63	48
<b>John Walsh, MA, DO'20</b> , David Hartigan, MD, Benjamin Domb, MD	G	
Progression of Radiographic Healing Following First Ray Arthrodesis in the Foot Using a Biplanar Plating Technique Without Compression .....	64	48
<b>Rachel Ellen Egdorf, DPM'19</b> , Andrea Cifaldi, DPM'18, Jake Eisenschink, DPM'19, Paul Dayton, DPM, MS, FACFAS	G	
Changes in Osseous Forefoot Angular Relationships, Force and Pressure Patterns in Association with Foot Flexibility and the Jones Fracture.....	65	49
Robert Yoho, DPM, MS, Vassilios Vardaxis, PhD, David Stapleton, BS, Amy Ross, DPM'20, <b>Jacob Harder, DPM'20</b>	G	
Comparison of Metabolic Bone Markers in Diabetics with Peripheral Neuropathy to Non-Diabetic Subjects .....	66	49
Robert Yoho, DPM, MS, FACFAS, <b>Brittany Nino, DPM'19</b> , Edee Wildman, DPM'20	G	

	Poster	Page
Shoulder Muscle Activation Synergies During Arm Elevation in Different Body Positions <b>David Stapleton, BS</b> , Samuel DeBoer, DPT'18, Traci Bush, DPT, OTR/L, DHS, Vassilios Vardaxis, PhD	67	50
Effect of Body Position on the Scapulothoracic Motion During Dynamic Dominant Arm Planar Elevation .....	68	50
<b>Vassilios Vardaxis, PhD</b> , Matthew Glazier, DO'19, David Stapleton, BS, Traci Bush, DPT, OTR/L, DHS		
Glenohumeral Joint Motion with Arm Elevation in the Frontal & Sagittal Plane at Common Clinical Evaluation Body Positions .....	69	51
<b>Vassilios Vardaxis, PhD</b> , Michael Maiden, David Stapleton, BS, Traci Bush, DPT, OTR/L, DHS		
Comparative EMG Analysis of Shoulder Girdle Muscles During Cardinal Plane Arm Elevation at Different Body Positions .....	70	51
<b>Traci Bush, DPT, OTR/L, DHS</b> , Asher Bogdanove, DPT'19, Clare Goerd, DPT'19, David Stapleton, BS, Vassilios Vardaxis, PhD		

## Effectors of PKA Signaling Regulate Carbohydrate Storage and Starvation Survival in *C. albicans* and *S. cerevisiae*

---

Zainab Tanveer<sup>1</sup> and Martin Schmidt, PhD<sup>2</sup>

<sup>1</sup> Iowa State University, Ames, IA

<sup>2</sup> Des Moines University, Des Moines, IA

Protein kinase A signaling mediates the adaptation to environmental conditions like nutrient availability and temperature in yeast. In the human pathogenic fungus *C. albicans*, the cAMP/PKA pathway induces genes that mediate the transition from yeast to hyphal growth through the transcription factor Efg1p. In addition to its well-documented role in the morphological transition, PKA signaling through Efg1 also regulates *C. albicans* energy metabolism and storage. We undertook a characterization of the influence of PKA/Efg1p on metabolism, fat synthesis and glycogen deposition – a considerably less-well understood connection. Our data show that loss of Efg1p function lowers glycogen content to 23% of wildtype, suggesting that Efg1 functions to stimulate reserve carbohydrate synthesis. Furthermore, we could demonstrate that strains lacking Efg1 have 178% of the triacylglycerol (fat) content of a wildtype. We found that during starvation, the glycogen-poor *efg1* mutant strains consume larger amounts of lipids and lose viability faster than the corresponding wildtypes. We observed a similar phenomenon in the well-studied model yeast *Saccharomyces cerevisiae*. In this yeast the PKA effector Sok2 (an Efg1 homolog) is a repressor of filamentous growth. We found that haploids *S. cerevisiae* strains lacking Sok2 have a glycogen content of 244% of the wildtype. We conclude that in both yeast species the expression of hyphal/pseudohyphal-specific genes in response to cAMP/PKA signaling is positively correlated with glycogen content.

◆ 2 G ◆

## Novel Assays Reveal Opposing Effects of 17 $\beta$ -estradiol in the Presence and Absence of Ovarian Hormones on the Cardiac Network of Calmodulin-Binding Proteins

---

Kyle Kaster, DO'20, John Patton, DO'20, Briana Gebert-Oberle, MBS, DPM'20, Sarah Clayton, PhD, Jennifer Giles, MA, Quang-Kim Tran, PhD, MD

Department of Physiology and Pharmacology, Des Moines University, Des Moines, IA

Calmodulin (CaM) is required for the activities of up to 300 cellular proteins yet is not sufficiently expressed for its binding targets. Reduced estrogen levels following menopause increase the incidence of cardiovascular disease. However, estrogen replacement therapy has not produced the desired therapeutic outcomes.

We have begun to examine the effects of 17 $\beta$ -estradiol (E<sub>2</sub>) on the cardiac CaM network. Female rats received sham surgery or ovariectomy, followed by treatment with vehicle or E<sub>2</sub> for 2 weeks. E<sub>2</sub> treatment in sham animals increases the interaction between endogenous CaM and the cardiac  $\alpha$  adrenergic receptor type 1A. Surprisingly, ovariectomy substantially increases this interaction, while E<sub>2</sub> replacement now reduces it. To examine the effects of these treatments on the population of cardiac CaM-binding proteins that are unsaturated by endogenous CaM, lysate from left ventricle was subjected to saturating Ca<sup>2+</sup> concentration and processed through a CaM sepharose column. Flow through contained CaM-binding sites saturated by endogenous CaM, while sepharose-bound fraction represented endogenously unsaturated CaM-binding sites. The fractions eluted from the CaM sepharose were subsequently used in competitive binding assays using purified CaM and a CaM biosensor. E<sub>2</sub> treatment in sham animals increases the number of unsaturated CaM-binding sites. Ovariectomy further increases this number, while E<sub>2</sub> treatment now reduces it.

The data indicate that E<sub>2</sub> treatment exerts opposing effects in the presence and absence of ovarian hormones on specific endogenous CaM-target association and the number of endogenously unsaturable Ca<sup>2+</sup>-dependent CaM-binding sites in the heart. These results suggest that estrogen replacement may have unpredictable functional outcomes.

## Contribution of Tonic Peripheral Chemoreflex Activation to Renal HIF1 $\alpha$ /miR-155 Expression in Chronic Heart Failure

---

Michael S. Weinfeld, DO'20<sup>1</sup>, Shaohan Deng, DO'20<sup>1</sup>, Jennifer Giles, MA<sup>1</sup>, Faithe Keomanivong<sup>1</sup>, Harold D. Schultz<sup>2</sup>, Rodrigo Del Rio<sup>3</sup>, Noah J. Marcus, PhD<sup>1</sup>

<sup>1</sup> Physiology and Pharmacology, Des Moines University, Des Moines IA

<sup>2</sup> Cellular and Integrative Physiology, University of Nebraska Medical Center, Omaha NE

<sup>3</sup> Laboratory of Cardiorespiratory Control, Pontificia Universidad Católica de Chile, Santiago, Chile

Recent evidence suggests a potential role for aberrant carotid body chemoreceptor (CBC) function in development of renal fibrosis and attendant kidney dysfunction in chronic heart failure (CHF). Tissue hypoxia, accumulation of Hypoxia-inducible factor 1- $\alpha$  (HIF1 $\alpha$ ), and activation of microRNA 155 (MiR-155) play prominent roles in activation of pro-fibrotic pathways in the kidney. We hypothesize that CBC-mediated increases in RSNA and decreases in RBF activate pro-fibrotic pathways in CHF by exacerbating tissue hypoxia, leading to accumulation of HIF1 $\alpha$  and upregulation of miR-155. To address this hypothesis, we measured expression of HIF1 $\alpha$  /MiR-155 in renal cortical tissue from CHF animals with and without ablation of the CBC (CBD). CHF was induced in rats by coronary artery ligation (CAL) and CBD was performed (4 weeks post-CAL) by cryogenic ablation. At 8 weeks post-CAL, rats were humanely euthanized and renal cortical tissue was collected and analyzed for HIF1 $\alpha$  /MiR-155 expression by western blot and RT-qPCR, respectively. Expression of HIF1 $\alpha$  was 1.4-fold higher in CHF rats relative to controls, and this effect was attenuated in CHF-CBD rats (1.25-fold higher than control). Conversely, MiR-155 expression was 0.5-fold lower in CHF and this effect was attenuated by CBD (0.7-fold relative to control). These results indicate that contrary to our working hypothesis, expression of renal cortical MiR-155 and HIF1 $\alpha$  does not change in parallel in CHF. Furthermore, these studies demonstrate that renal MiR-155 is downregulated in CHF and that CBD attenuates this effect, suggesting a novel relationship between CBC function and MiR-155 signaling in the kidney.

## Microglial Activation During Sensitization-Induced Hypertension in Rats

---

Erika Roust, DO'20<sup>1</sup> and Sarah Clayton, PhD<sup>2</sup>

Department of Physiology and Pharmacology, Des Moines University, Des Moines, IA

Essential hypertension is a clinical condition that plagues millions of Americans, leading to more dangerous cardiovascular disease. The precise mechanisms that lead to essential hypertension are incompletely understood. By studying and identifying causes of hypertension, therapies can be improved resulting in better clinical outcomes. Previously, work in the lab has shown that sensitization with sub-pressor doses of angiotensin II (ANGII) and aldosterone (ALDO), given subcutaneously or directly into the brain (icv) augment the response to a later hypertensinogenic stimulus. It is known that this sensitization paradigm induces a pro-inflammatory state in the brain, increases sympathetic activity and augments the blood pressure. In the current study, we hypothesized that microglia are activated during sensitization-induced hypertension and can influence neuronal function. To test this, tissue samples from the subfornical organ (SFO), organum vasculosum of lamina terminalis (OVLT), and paraventricular nucleus (PVN) from animals that underwent induction with icv ANGIIL or ALDO were tested for expression of Iba-1, a marker of microglial activation, via RT-qPCR. The results revealed Iba-1 expression was increased ~1.5-fold from sham in the PVN with icv ALDO treatment. A 1.2-fold increase in icv ANGIIL-treated OVLT was also observed. These results show induction does influence microglial activation in the central nervous system in a distinct spatial manner (i.e. in the PVN and OVLT but not the SFO). This finding suggests microglia could contribute to the enhanced blood pressure response in this model. A better understanding of the role of microglia in blood pressure regulation may yield important future therapeutic targets.

## Glucocorticoid Signaling Regulates Activation of Hippocampal MKP-1 During Stress

---

**Tyler Folkerts, DO'20**, Cory Langreck, Dakota Nerland, MBS'21, Lori Semke, BS, Brad Lamb, Eric Wauson, PhD, Vanja Duric, PhD

Department of Physiology and Pharmacology, Des Moines University, Des Moines, IA

Major Depressive Disorder (MDD) is a commonly occurring and debilitating mental illness characterized by negative mood changes. The exact etiology of MDD is not well understood, however, clinical and preclinical evidence suggests that prolonged exposure to stress and altered function of limbic brain areas, such as the hippocampus, are key factors that contribute to development and maintenance of a depressive state. We previously reported that MAP Kinase Phosphatase 1 (MKP-1), a negative regulator of MAP kinase signaling pathway, is overexpressed within hippocampal subregions of depressed human brains. In the current study, glucocorticoid receptor (GR) signaling was investigated as a potential regulator of hippocampal MKP-1 expression. Treatment with the GR agonist dexamethasone significantly increased MKP-1 mRNA levels within the rat hippocampus at 1, 2, and 4 hours post treatment. Similarly to dexamethasone, exposure to acute restraint stress (ARS; i.e., 1 hr of immobilization) also evoked upregulation of hippocampal MKP-1 gene expression; however, this upregulation was transient and MKP-1 mRNA levels returned to baseline (i.e., similar to unstressed controls) as early as one hour after the end of ARS. We also investigated whether GR blockade could prevent stress-induced expression of MKP-1. Administration of the GR antagonist mifepristone 30 min before the initiation of ARS produced only a partial blockade of MKP-1 upregulation, suggesting that stress-mediated MKP-1 activation utilizes, in part, molecular mechanisms independent of the GR activation. Additionally, we demonstrated that hippocampus-specific MKP-1 knockdown via CRISPR approach produced antidepressant effects by inhibiting development of depressive-like behaviors in response to chronic glucocorticoid exposure.

Supported by a PhRMA Foundation Starter Grant (V.D.) and Iowa Osteopathic Education and Research Funds (V.D.).

## Effects of Stress on the Human Gut Microbiome

---

Joseph Johnson, DO'19, Devraux Boshard, DO'20, Aaron Shoskes, DO'18, Chunfa Jie, PhD, **LiLian Yuan, PhD**

Department of Physiology and Pharmacology, Des Moines University, Des Moines, IA

The central nervous system (CNS) and gastrointestinal (GI) tract interact via bidirectional communication, and the microbiota of the gut play an important role in mediating this signaling. Our interest lies in the effect of stress on GI microbiota and the role the microbiome plays in coping with stress. We intend to investigate the relationship between chronic stress and the gut microbiota in our own medical students, by comparing the taxonomic composition present in fecal samples before and after various amount of time in medical school. Incoming first-year medical students were recruited (n=31) for the study. Using stress/anxiety surveys and physiological measures such as blood cortisol levels, we evaluate their levels of stress before their first year starts and at two additional time points throughout their first semester. Additionally, GI microbiome samples are taken to assess gut microbial populations at each time point. Our data illustrated an overall increase in stress and depression levels with the amount of time in medical school, which is accompanied with changes in gut microbiota abundance at all taxonomy levels. For example, a significant increase in the ratio of *firmicutes: bacteroidetes* (F: B), the largest phyla in human gut microbiome. Increased F: B ratio has been linked with poorer health/obesity in humans. Future research will be aimed at identifying the genes and signaling pathways that mediate stress-induced human gut microbiome changes as revealed in this study. Results may shed light on potential treatment to reduce stress/anxiety in general, as well as to promote wellbeing of our future health care providers and physicians.

## Synaptic Potentiation, Cytoskeletal Remodeling, and Rapid-Acting Antidepressant Actions

---

Zarin Rehman<sup>1</sup>, Amy Eisenberg, DO'20, MHA'22<sup>1</sup>, Nico Gotera, DO'20, MPH'21<sup>1</sup>, Saiumamaheswari Saichellappa, MBS'20<sup>1</sup>, Laura Herring<sup>2</sup>, Lori Semke, BS<sup>1</sup>, Eric Wauson, PhD<sup>1</sup>, Lee Graves<sup>2</sup>, Vanja Duric, PhD<sup>1</sup>, LiLian Yuan, PhD<sup>1</sup>

<sup>1</sup> Department of Physiology and Pharmacology, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Pharmacology, University of North Carolina, Chapel Hill, NC

Ketamine at sub-anesthetic doses has shown promising results as a potent and fast-acting antidepressant. Evidence from animal model studies suggests that the functional restoration by ketamine is associated with activation of MAPK and mTOR signaling cascades in the prefrontal cortex (PFC) within a few hours of ketamine administration, followed by a second wave of synaptic protein upregulation. Together, these molecular events lead to rapid synaptogenesis and reversal of neural atrophy. Furthermore, (2*R*, 6*R*)-hydroxynorketamine (HNK) has recently been identified as the main active component of ketamine metabolism. HNK is believed to be responsible for the antidepressant actions of ketamine, but with minimal side effects, and potentially through NMDAR-independent mechanism of action. However, critical gaps exist in understanding the exact molecular mechanisms of ketamine actions. Thus, it would be of great importance and interest to delineate the molecular mechanisms that translate mTOR activation into synaptogenesis-based structural remodeling. Cofilin and its upstream pathways, ideally positioned to bridge the gap between mTOR activation and spine formation, have emerged from an unbiased kinome and phosphoproteome screening for targets of ketamine treatment. As the major cytoskeletal component of dendritic spines, actin controls spine morphology and formation through changes in its polymerization state. Actin polymerization is negatively regulated by activation of cofilin protein. Further studies are currently underway to address the significance of cofilin phosphorylation and actin polymerization in synaptic potentiation induced by ketamine and HNK.

NIH grant MH108043

IOER funds

IACUC protocol # 11-16-02

## Silencing of Calcineurin Homologous Protein-2 Restores the Regulation of pH by Growth Factors in Osteosarcoma Cells

---

Adam P. Zobel, DO'20<sup>1</sup>, Silkman David, PA'19<sup>1</sup>, Jordan J.R. Baker, DO'19<sup>1</sup>, Elitsa Ananieva, PhD<sup>2</sup>, Victor Babich, PhD<sup>1,3</sup>, Francesca Di Sole, PhD<sup>1</sup>

<sup>1</sup> Department of Physiology and Pharmacology, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Biochemistry and Nutrition, Des Moines University, Des Moines, IA

<sup>3</sup> School of Liberal Arts and Sciences, Mercy College of Health Sciences, Des Moines, IA

Current treatment options for osteosarcoma are often ineffective, therefore, it is essential to explore novel therapeutic treatment approaches. Dysregulation of pH dynamics is a main adaptive feature of cancer cells and is due primarily to the increased activity of the Na<sup>+</sup>/H<sup>+</sup> exchanger-1 (NHE1), the main transporter responsible for pH regulation. Despite the availability of NHE1 inhibitors that reduce cancer progression, the undesired off-target effects on non-cancerous cells result in major limitations with their application. A clinically promising NHE1 blockade should inhibit NHE1 activity in cancerous, but not in non-cancerous cells. The Calcineurin Homologous Protein (CHP) is a family (isoforms 1 to 3) of NHE1 regulatory binding partners. CHP1 is expressed in non-cancerous cells; whereas, CHP2 is expressed mainly in cancerous cells, binding to NHE1 in cancerous cells, specifically. This study investigates whether the silencing of CHP2 restores the regulation of NHE1 activity in a human osteosarcoma cell line (143B cells) that expresses endogenous CHP2 and NHE1. In 143B cells, NHE1 activity was measured after the removal of growth factors (serum deprivation) to mimic a tumor microenvironment. NHE1 activity was not affected by 24 or 48 hours of serum deprivation; but, it was reduced by serum deprivation when CHP2 expression was silenced using shRNA. In summary, pH dysregulation in osteosarcoma cells is dependent on the CHP2 binding to NHE1. Accomplishment of these studies will aid in determining the potential of targeting CHP2, an NHE1 cofactor, as a novel and selective anti-cancer therapeutic treatment; particularly, in the treatment of osteosarcoma.

## Silencing of MAP Kinase Phosphatase 1 Blocks the Renal Inflammatory Response Induced by Chronic Stress

---

**Miranda M. Roland, DO'20<sup>1</sup>**, Cory Langreck<sup>1</sup>, Vanja Duric, PhD<sup>1</sup>, Victor Babich, PhD<sup>1,2</sup>, Francesca Di Sole, PhD<sup>1</sup>

<sup>1</sup> Department of Physiology and Pharmacology, Des Moines University, Des Moines, IA

<sup>2</sup> School of Liberal Arts and Sciences, Mercy College of Health Sciences, Des Moines, IA

Chronic stress can disrupt the body's systemic equilibrium which may correspond to dysfunction of nervous and peripheral organ systems. A relationship between chronic stress, mood disorders (e.g. major depression) and systemic disease (e.g. kidney disease) is proposed via a systemic immune reaction and increased levels of proinflammatory cytokines. This study aims to determine whether: 1. chronic stress induced by exposure of rats to corticosterone (CORT) in drinking water for 3 weeks associates with a renal immune reaction and 2. silencing of MAP Kinase Phosphatase 1 (MKP-1) affects the renal immune reaction mediated by CORT. MKP-1 is a negative regulator of the MAP kinase signaling which is overexpressed within depressed human hippocampal sub-regions and is fundamental for the development of depressive-like behaviors in rodent model of chronic stress. The neutrophil gelatinase-associated lipocalin (NGAL) and IL-18 are early diagnostic biomarkers and were analyzed by immunocytochemistry. These accumulate in the kidney in response to inflammation and injury. NGAL and IL18 protein levels were significantly increased in rats treated with CORT compared to their controls (over 70% increase in NGAL and IL18 protein levels in the glomeruli, 40% increase in NGAL and 6% increase in IL18 protein levels in the tubules). The increase in NGAL and IL18 levels were blocked through silencing MKP-1 protein expression via Cas9 prior to CORT exposure. In summary, renal inflammation induced by chronic stress was blocked by MKP1 silencing, therefore supporting the therapeutic potential of MKP-1 as target for signaling pathways between chronic stress, mood disorders, and kidney dysfunction.

◆ 10 G ◆

## Lactate, mTORC1, and AMPK are Differentially Impacted by Modulations in Leucine Uptake and Catabolism in Bone Sarcomas

---

**William Reiche, DO'20**, Shailer Martin, DPM'19 MBS'17, Michael Boyer, BS, Elitsa Ananieva, PhD

Department of Biochemistry and Nutrition, Des Moines University, Des Moines, IA

Osteosarcoma and chondrosarcoma are rare, devastating bone sarcomas with low survival rates. Currently, the prognosis for individuals with bone sarcomas depends upon the patient's response to chemotherapy and surgical intervention. A novel approach to treat bone sarcomas is to target leucine, an indispensable amino acid for tumor growth. Our objective was to elucidate how modulations in leucine uptake and catabolism impact metabolic (glycolysis) and signaling (mammalian target of rapamycin complex1, mTORC1, and AMP-activated protein kinase, AMPK) pathways in osteosarcoma (143B) and chondrosarcoma (SW1353) cells. To achieve this objective, we treated 143B and SW1353 cells with a leucine antagonist, N-acetyl-leucine-amide (NALA), and an inhibitor of leucine degradation, gabapentin, for 24hrs and measured: lactate release and activity of mTORC1 and AMPK in the presence of 0 and 5mM glucose. Next, we compared the effects of NALA and gabapentin to rapamycin (inhibitor of mTORC1) and 2-Deoxy-D-glucose (2-DG, inhibitor of glycolysis). Our results showed that NALA and gabapentin inhibited lactate release from 143B cells in the presence of 5mM glucose, which strongly correlated with decreased mTORC1 but increased AMPK activity. In contrast, there was either no effect (gabapentin) or an increase (NALA) in lactate secretion from SW1353 that correlated with increased mTORC1 activity under 0 and 5mM glucose. Compared to 2-DG, NALA and gabapentin showed a milder inhibitory effect on lactate release from 143B cells, which could result in less side effects in cancer patients. Thus, inhibiting lactate secretion by targeting leucine could be a promising anticancer treatment in patients with osteosarcoma but not chondrosarcoma.

## Generation of Mice with a Loss of Function of the Cytosolic Branched Chain Aminotransferase 1 (BCAT1) in T cells: Breeding Strategy

---

Sean McNitt, DO'20, Michelle Brenner, DO'19, Michael Boyer, BS, Elitsa Ananieva, PhD

Department of Biochemistry and Nutrition, Des Moines University, Des Moines, IA

T cells quickly respond to pathogens by transitioning to highly proliferative state. This process is dependent on nutrients such as the amino acid leucine. To explore the role of leucine metabolism in T cells, we developed a breeding strategy that allowed us to delete the first gene in leucine degradation (branched chain aminotransferase 1, BCAT1) by utilizing the Cre-LoxP strategy. For this purpose, we used the floxed BCAT1 mouse that contains a transgenic BCAT1 gene flanked between 2 LoxP sites. Another mouse, called CD4-Cre, contains a Cre recombinase, that can catalyze recombination between the 2 LoxP sites under the control of T cell specific CD4 promoter, and can cause deletion of the floxed BCAT1 gene from T cells. A series of three breedings were undertaken to achieve a total deletion of BCAT1 from T cells (T-BCAT1<sup>-/-</sup> mice). The first breeding, between heterozygous floxed BCAT1 mice, resulted in 26.3% of the offspring being homozygous floxed BCAT1 mice. The second breeding, between homozygous floxed BCAT1 and CD4-Cre mice, created an offspring that was heterozygous by the floxed BCAT1 gene and hemizygous by the CD4-Cre gene (57.1% of offspring). The third breeding, between mice heterozygous by the floxed BCAT1 and hemizygous by CD4-Cre with mice homozygous by the floxed BCAT1 gene, achieved complete deletion of BCAT1 from T cells (33% of the offspring). Next, we will use these animals to explore the role of BCAT1 in T cell immunity, which will ultimately lead to the development of new metabolic approaches for immunotherapy and cancer.

## Investigating the Effects of NALA (a Leucine Antagonist) and AICAR (an AMPK Activator) on the Energy Status and the Growth of Osteosarcoma Cells

---

Alexander Schultz, DPM'21, Shailer Martin, DPM'19 MBS'17, Michael Boyer, BS, Elitsa Ananieva, PhD

Department of Biochemistry and Nutrition, Des Moines University, Des Moines, IA

Bone tumors are the 7<sup>th</sup> most common tumors in adolescents (ages 15-19) with more prevalence in males than females. Osteosarcoma, a type of bone tumor, has typically poor prognosis. In search for new approaches to treat osteosarcoma, our research focused on targeting leucine, a key essential amino acid that has a role in supporting tumor metabolism. Our objective was to investigate the energy status and the growth of osteosarcoma cells in the presence of the leucine structural antagonist, N-acetyl-leucine-amide (NALA) and compare to AICAR, an activator of the energy sensing kinase AMPK. We hypothesized that NALA would block the uptake of leucine into the cells thus impacting the ability of the cells to produce ATP and grow, while AICAR would stimulate AMPK thereby reducing downstream mTORC1 pathway and cell growth. To test our hypothesis, we treated osteosarcoma (143B) cells with 25mM NALA and measured ATP production, AMPK activity, and cellular growth. We then measured the implications of introducing AICAR into the osteosarcoma 143B cells. AMPK and mTORC1 activity, as well as cellular growth, were tested using varying concentrations of AICAR (range 0-8 mM). Results revealed that NALA caused a decrease in ATP production, an increase in AMPK activity, and a decrease in overall cellular growth. These findings were comparable to the effects of AICAR, which caused an increase in AMPK activity, a decrease in mTORC1 and reduction in the growth of osteosarcoma cells. The results suggest that targeting leucine could prove valuable in developing new treatment options for osteosarcoma patients.

## The Differential Effect of IL-39 on Two Different Prostate Cancer Cell Lines

---

**Theodore Stewart-Hester, DO'20<sup>1</sup>**, Huaping Xiao<sup>1</sup>, Ziwen Zhu<sup>2</sup>, Qian Bai<sup>2</sup>, Chase Redington<sup>2</sup>, Jolie W. Chan<sup>2</sup>, Zackary E. Hunzeker<sup>2</sup>, Vivi A. Ding<sup>1</sup>, Mark R. Wakefield<sup>2</sup>, Yujiang Fang, PhD, MD<sup>1, 2</sup>

<sup>1</sup> Department of Microbiology and Immunology, College of Osteopathic Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Surgery, University of Missouri School of Medicine, Columbia, MO

**Background:** Prostate cancer (PCa) is the most common male malignancy. IL-39 is a new member of the IL-6/IL-12 heterodimeric cytokine family produced mainly by epithelial cells and activated mononuclear cells. Its role in immunity has been studied, however, nothing is known about its role in cancer. This study investigated the effect of IL-39 on the growth of PCa.

**Methods:** Clonogenic survival assay, cell proliferation and caspase-3 activity kits were used to evaluate the direct effects of IL-39 on cell survival, proliferation and apoptosis of the two widely studied PCa cell lines PC-3 and DU145. We investigated possible molecular mechanisms by using RT-PCR.

**Results:** We found that IL-39 had little effect on growth or apoptosis of PC-3 cells, however, the percentage of colonies of DU145 cells significantly increased after treatment with IL-39. This was echoed by the increase in the OD value of DU145 cells after treatment with IL-39. The relative caspase-3 activity in DU145 cells also decreased in the presence of IL-39. The pro-proliferative effect of IL-39 on DU145 cells correlated with downregulation of the anti-proliferative molecule p21 and upregulation of the pro-proliferative molecule cyclin E and cdk2. The anti-apoptotic effect of IL-39 correlated with downregulation of the pro-apoptotic molecule TRAIL.

**Conclusions:** IL-39 exerts a powerful pro-tumor effect on DU145 prostate cancer cells, but has little effect on PC-3 prostate cancer cells, suggesting its differential effect on these two cell lines. Further studies might be helpful to develop a promising immunotherapeutic strategy to treat PCa by inhibiting the effect of IL-39.

## IL-29 Exhibits Anti-Tumor Effects on Pan-48 Pancreatic Cancer by Upregulation of P21 and Bax

---

**Dean Balabanov, DO'20<sup>1</sup>**, Ziwen Zhu<sup>2</sup>, Huaping Xiao<sup>1</sup>, Zackary E. Hunzeker<sup>2</sup>, Hannah M. Tonner<sup>2</sup>, Vivi A. Ding<sup>1</sup>, Mark R. Wakefield<sup>2</sup>, Qian Bai<sup>2</sup>, Theodore Stewart-Hester, DO'20<sup>1</sup>, Jolie W. Chan<sup>2</sup>, Yujiang Fang, PhD, MD<sup>1, 2</sup>

<sup>1</sup> Department of Microbiology and Immunology, College of Osteopathic Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Surgery and Ellis Fischel Cancer Center, University of Missouri School of Medicine, Columbia, MO

**Background:** IL-29, a new member of the IFN $\lambda$  family, is well-known for its strong antiviral activity. However, its direct effect on pancreatic cancer is still unclear. We have previously reported that IL-29 promoted growth of MiaPan-2 pancreatic cancer cells by upregulation of cyclin B and survivin. This study was performed to investigate if it has any direct effect on another widely used pancreatic cancer cell line, Pan-48.

**Methods:** Clonogenic survival assay, cell proliferation, and caspase-3 activity kits were used to evaluate the effects of IL-29 on cell survival, proliferation, and apoptosis of another well-studied pancreatic cancer cell line, Pan-48. We further investigated the potential molecular mechanisms by using RT-PCR and IHC.

**Results:** We found that the percentage of colonies of Pan-48 cells was decreased after the addition of IL-29. This was consistent with a decreased OD value of cancer cells. Furthermore, the relative caspase-3 activity in cancer cells were also increased after the addition of IL-29. The anti-proliferative effect of IL-29 on cancer cells correlated with increased expression of the anti-proliferative molecule, p21. The pro-apoptotic effect of IL-29 on cancer cells correlated with increased expression of the pro-apoptotic molecule Bax.

**Conclusions:** Although IL-29 favours the inhibition of MiaPan-2 pancreatic cancer cell growth, it also constrains Pan48 pancreatic cell growth by upregulation of p21 and Bax. This strongly indicates that the role of IL-29 in cancer cells is cell line specific.

## IL-39 Acts as a Friend to Pancreatic Cancer

---

**Alicia A. Manning, DO'20<sup>1</sup>**, Ziwen Zhu<sup>2</sup>, Huaping Xiao<sup>1</sup>, Vivi A. Ding<sup>1</sup>, Theodore Stewart-Hester, DO'20<sup>1</sup>, Qian Bai<sup>2</sup>, Joseph Schmidt<sup>2</sup>, Nick Caruso<sup>2</sup>, Jacob Dunlap<sup>2</sup>, Benjamin G. Tlapec<sup>2</sup>, Aldo Dominguez<sup>2</sup>, Mark R. Wakefield<sup>2</sup>, Yujiang Fang, PhD, MD<sup>1, 2</sup>

<sup>1</sup> Department of Microbiology and Immunology, College of Osteopathic Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Surgery, University of Missouri School of Medicine, Columbia, MO

**Background:** Pancreatic cancer is the most lethal digestive cancer and the fourth leading cause of cancer death in US. IL-39, a heterodimer of p19 and EBI3, is a newly found cytokine and its role in the pathogenesis of neoplasia has not been studied yet. We have previously reported that IL-33 as well as IL-37 inhibits growth of pancreatic cancer cells. This study was designed to investigate the direct role of IL-39 in the growth of Pancreatic cancer.

**Methods:** Clonogenic survival assay, cell proliferation and caspase-3 activity kits were used to evaluate the direct effects of IL-39 on cell survival, proliferation and apoptosis of the widely studied pancreatic cancer cell line MiaPan-2. We further investigated the possible molecular mechanisms by using RT-PCR and IHC.

**Results:** The percentage of colonies of pancreatic cancer cells increased significantly in the presence of IL-39. This was paralleled with the increase in the OD value of cancer cells in the presence of IL-39. Interestingly, the relative caspase-3 activity in cancer cells decreased significantly in the presence of IL-39. Furthermore, the pro-tumor effect of IL-39 on pancreatic cancer cells correlated with decreased anti-proliferative molecule p21. The anti-apoptotic effect of IL-39 correlated with decreased pro-apoptotic molecule TRAILR1.

**Conclusions:** IL-39 favors growth of pancreatic cancer by promoting growth and inhibiting apoptosis of cancer cells. This suggests that IL-39 acts as a friend to pancreatic cancer. Thus, inhibition of effect of IL-39 on cells might be a promising strategy to treat pancreatic cancer.

## Pineapple Extract Has Little Effect on the Growth of Lung Cancer Cells Although It Inhibits Growth of Normal Bronchial Epithelials

---

**Andrew Ames, DO'20<sup>1</sup>**, Huaping Xiao<sup>1</sup>, Ziwen Zhu<sup>2</sup>, Noah J. England<sup>2</sup>, Aldo Dominguez<sup>2</sup>, Mark R. Wakefield<sup>2</sup>, Qian Bai<sup>2</sup>, Vivi A. Ding<sup>1</sup>, Ted W. Stewart-Hester, DO'20<sup>1</sup>, Yujiang Fang, PhD, MD<sup>1,2</sup>

<sup>1</sup> Department of Microbiology, Immunology and Pathology, College of Osteopathic Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Surgery, University of Missouri School of Medicine, Columbia, MO

**Background:** Lung cancer is still the leading cause of cancer related death. Some natural chemicals from fruits and vegetables have been shown to be beneficial to cancer patients. We have previously reported that pumpkin extract inhibits the growth of lung cancer cells while having little effect on normal bronchial epithelials. Pineapple extract (PaE) has been used as a folk medicine for centuries. In recent years, its effect on human cancer cells such as GI cancer and mesothelioma have been studied, however, its direct effect on human lung cancer cells has not been reported. This study was performed to investigate if PaE has any direct effect on lung cancer cells as well as on normal bronchial epithelials, and to characterize possible underlying mechanisms of its action on each.

**Methods:** Clonogenic survival assay, cell proliferation and caspase-3 activity kits were used to evaluate the effects of PaE on cell survival, proliferation and apoptosis of a widely used lung cancer cell line, A549, as well as on the normal bronchial epithelial cell line, B2B. We then further investigated the possible molecular mechanisms of any aforementioned changes with RT-PCR.

**Results:** We found that PaE had little effect on growth or apoptosis of lung cancer cells. However, the percentage of colonies and the OD value of normal epithelial B2B cells decreased in the PaE treated group compared to those in medium alone. The relative caspase-3 activity in B2B cells increased in the PaE group compared to those in medium alone. The anti-proliferative effect of PaE on B2B cells correlated with decreased expression of the pro-proliferative molecule cyclin D. The pro-apoptotic effect of PaE on B2B cells correlated with a decreased expression of the anti-apoptotic molecules FLIP and Bcl-2.

**Conclusion:** PaE has little anti-tumor effect on lung cancer cells despite of its growth inhibiting effect on normal bronchial epithelial cells.

## FcγR-Mediated Signaling is Regulated by C1q

---

Anna Jokinen, E.A. Willmann, Vesna Pandurovic, BS, Rachel Anderson, MS, Suzanne Bohlson, PhD

Des Moines University, Des Moines, IA

A deficiency in C1q, the recognition component in the classical complement pathway, is the strongest genetic link to development of Systemic Lupus Erythematosus (SLE). SLE is an autoimmune disease that results from the build-up of immune complexes (IC), and subsequent IC-mediated propagation of the inflammatory response through Fcγ receptors (FcγR) on myeloid cells. *It has been previously demonstrated that C1q enhances FcγR-mediated phagocytosis*, and here we tested the hypothesis that C1q regulates the signal transduction cascade downstream of FcγRs. To investigate this regulation, we measure ERK1/2 activation, a MAP kinase, downstream of the FcγR. ERK phosphorylation is downregulated following 30 minute stimulation with C1q, and the addition of IC triggers ERK1/2 phosphorylation within 10 minutes. Phosphorylation of p38 and JNK, two additional MAP kinases, was not regulated by C1q or IC. Inhibition of ERK1/2 blocked C1q-dependent phagocytosis, in mouse and human phagocytes. These studies demonstrate a critical role for ERK1/2 in C1q-dependent phagocytosis.

## Herpes Simplex Virus 1 Inhibition by Co-Administration of Acyclovir and the Telomerase Inhibitor MST-312

---

Neil Febel<sup>1</sup>, Prajakta Pradhan, MS<sup>2</sup>, Marie Nguyen, PhD<sup>2</sup>

<sup>1</sup> Drake University, Des Moines, IA

<sup>2</sup> Des Moines University, Des Moines, IA

The herpes simplex virus (HSV) is an infectious agent which can lead to a variety of detrimental effects in humans. While the most common symptoms of HSV infections are the manifestation of cold sores, more severe infections can lead to serious complications such as blindness, encephalitis, and meningitis. MST-312 is a telomerase inhibitor with a structure modeled after green tea leaf catechins. Other research has demonstrated that MST-312 is able to inhibit HSV replication, but has yet to explore the drug's effectiveness when used in combination with established antivirals. In our experiments, we compared the antiviral effects of MST-312 as a lone treatment against its effectiveness when used in combination with the already established antiviral, Acyclovir (ACV). Both HEp-2 and Vero cells were infected with HSV-1[KOS 1.1] and treated with MST-312, ACV, or a mix of the two treatments. Virus was then harvested post treatment and quantified through a series of plaque assays. These values were compared with the plaque counts of an untreated virus infection in order to determine the relative effectiveness of each treatment. In both the HEp-2 and Vero cells, the combination of MST-312 and ACV had a much greater effect than either individual treatment. Further analysis showed that the viral inhibition of the combined treatment was greater than the summed effects of the individual treatments. These results suggest that MST-312 and ACV may have a synergistic antiviral effect against HSV when used in tandem.

## Extracting 3D Surface Data from the Endocasts of Fossil Canids and Felids

---

Ian Glidden<sup>1</sup>, Kathleen Bitterman, BS<sup>2</sup>, Paul R. Manger<sup>3</sup>, Rachel H. Dunn, PhD<sup>2</sup>, Muhammad A. Spocter, PhD<sup>2,3</sup>

<sup>1</sup> Department of Biomedical Sciences, Iowa State University, Ames, IA

<sup>2</sup> Department of Anatomy, Des Moines University, Des Moines, IA

<sup>3</sup> School of Anatomical Sciences, University of the Witwatersrand, Johannesburg, Republic of South Africa

Brain endocasts (both natural and artificial) are traditionally created by casting the internal surface of the cranial vault to provide paleobiologists with a snapshot of the external anatomy of the brain. In conjunction with our understanding of brain morphology in extant species, endocasts allow us to reconstruct the evolutionary history of brain expansion in a particular lineage and generate hypotheses on the behavioral capabilities of now extinct species. In recent years, the use of virtual endocasts and the advent of new imaging techniques have expanded this field to allow for the extraction and reconstruction of surface data in three-dimensional space. In the following study, we undertook a preliminary investigation of the use of virtual 3D surface models created by scanning artificial endocasts of fossil canids and felids (spanning some 30 million years). These endocasts were scanned using the NextEngine 3D scanner and accompanying processing software. Volumetric data on brain volume, surface area and relative sulcal lengths were extracted from each specimen and compared across taxa using standard regression analysis techniques. Here we discuss key sulcal landmarks and the topographical changes in sulcal morphology which accompanied major evolutionary transitions in fossil Canidae and Felidae. Our results demonstrate that three-dimensional surface models are a useful tool for mining surface features in fossil carnivores.

## A Preliminary MRI and DTI Brain Atlas of the Siberian Tiger (*Panthera tigris altaica*)

---

Victoria Knauf, DPM<sup>1</sup>19<sup>1</sup>, June E. Olds<sup>2</sup>, Rachel Derscheid<sup>3</sup>, Johnny C. Ng<sup>4</sup>, Victoria X. Wang<sup>4</sup>, Cheuk Tang<sup>4</sup>, Bridget Wicinski<sup>5</sup>, Patrick R. Hof<sup>5</sup>, Chet C. Sherwood<sup>6</sup>, Paul R. Manger<sup>7</sup>, Muhammad A. Spocter, PhD<sup>1,7</sup>

<sup>1</sup> Department of Anatomy, Des Moines University, Des Moines, IA

<sup>2</sup> College of Veterinary Medicine, Iowa State University, Ames, IA

<sup>3</sup> Veterinary Diagnostic Laboratory, Iowa State University, Ames, IA

<sup>4</sup> Departments of Radiology and Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY

<sup>5</sup> Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, NY

<sup>6</sup> Department of Anthropology, George Washington University, Washington, DC

<sup>7</sup> School of Anatomical Sciences, University of the Witwatersrand, Johannesburg, Republic of South Africa

The Siberian tiger (*Panthera tigris altaica*) is the largest member of the Panthera and also one of the most endangered big cats in the world, with recent census data suggesting a wild population of less than 600 individuals. Owing to their protected status and declining numbers in the wild, we know very little about the brain of the Siberian tiger and how it compares with other feline species. Using postmortem brain tissue obtained through collaboration with Iowa State University and the Blank Park Zoo, we derived a preliminary MRI and diffusion tensor brain atlas based on the brain of an 18-year-old female Siberian tiger that was humanely euthanized for age-related quality of life concerns. Using quantitative magnetic resonance imaging, cortical white and grey matter volumes, as well as global gyrification index and cortical thickness maps were derived and compared with available data for other mammals. While preliminary, this study provides the first MRI and DTI map of the Siberian tiger brain and offers much needed comparative data for ongoing studies on felid brain evolution.

## The Brain of the African Painted Dog (*Lycaon pictus*): MRI Atlas, Diffusion Tensor Imaging and Quantitative Volumetrics

---

Jonathan Tenley, DPM<sup>1</sup>19, MSA<sup>1</sup>17<sup>1</sup>, Samson Chengetanai<sup>2</sup>, Jennifer Niederlander<sup>3</sup>, Megan Duncan<sup>3</sup>, Johnny C. Ng<sup>4</sup>, Victoria X. Wang<sup>4</sup>, Cheuk Tang<sup>4</sup>, Bridget Wicinski<sup>5</sup>, Patrick R. Hof<sup>5</sup>, Paul R. Manger<sup>2</sup>, Muhammad A. Spocter, PhD<sup>1,6</sup>

<sup>1</sup> Department of Anatomy, Des Moines University, Des Moines, IA

<sup>2</sup> School of Anatomical Sciences, University of the Witwatersrand, Johannesburg, Republic of South Africa

<sup>3</sup> Veterinary Diagnostics, Indianapolis Zoo, Indianapolis, IN

<sup>4</sup> Departments of Radiology and Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY

<sup>5</sup> Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, NY

<sup>6</sup> Department of Anthropology, George Washington University, Washington, DC

The African Painted dog (*Lycaon pictus*) is native to Sub-Saharan Africa and belongs to the family Canidae which includes domestic dogs and a group of their closest living ancestors (i.e., wolves, coyotes, jackals and foxes). This peculiar canid is known for its highly social behavior and vocal repertoire however, very little is known about the brain of the African Painted dog and how this might vary from that of other canids. To address this caveat, we created a preliminary MRI brain atlas using postmortem scan data obtained from the brains of three African Painted dogs. MR sequences were acquired at 7 Tesla and post processing of the MRI scans were undertaken using Analyze 10.0 and DTI-Query. Cortical white and grey matter volumes, as well as the species gyrification index and cortical thickness map was derived and compared across species. While preliminary, this study provides the first MRI and DTI map of the brain of the African Painted dog and offers much needed baseline data for this understudied species.

## The Gyrfication Index of the Domestic Dog

---

Victoria Knauf, DPM'19<sup>1</sup>, Tuan Truong<sup>2</sup>, Geoffrey Aguirre<sup>3</sup>, Ritobrato Datta<sup>3</sup>, Johnny Ng<sup>4</sup>, Victoria X. Wang<sup>4</sup>, Cheuk Tang<sup>4</sup>, Bridget Wicinski<sup>5</sup>, Patrick R. Hof<sup>5</sup>, Chet C. Sherwood<sup>6</sup>, Paul R. Manger<sup>7</sup>, Muhammad A. Spocter, PhD<sup>1,7</sup>

<sup>1</sup> Department of Anatomy, Des Moines University, Des Moines, IA

<sup>2</sup> Des Moines Public Schools, Central Campus, Des Moines, IA

<sup>3</sup> Department of Neurology, University of Pennsylvania, Philadelphia, PA

<sup>4</sup> Departments of Radiology and Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY

<sup>5</sup> Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, NY

<sup>6</sup> Department of Anthropology, George Washington University, Washington, DC

<sup>7</sup> School of Anatomical Sciences, University of the Witwatersrand, Johannesburg, Republic of South Africa

One of the most conspicuous features of all large brained mammals is the marked folding of the outer cortical surface of the brain (i.e., gyrification). This folding pattern of the brain is argued to be indicative of the functional complexity of the cerebral cortex and its information processing capacity. However, very little is known about the degree of intraspecific variation in gyrification and what features if any might contribute to increased folding in mammalian species. In the current study, we used postmortem magnetic resonance imaging data to evaluate the degree of cortical folding in a sample of 15 domestic dogs. The aim of this study was to demonstrate whether or not the gyrification index varied in a predictable fashion with cortical white matter volume. While preliminary, our analyses indicate a lack of association between the volume of total cortical white matter and the degree of gyrification. This data is discussed in light of prevailing theories on the mechanism involved in cortical folding.

## What Can the Scapholunar Bone Tell Us About the Locomotion and Habitat of Extinct Carnivores?

---

Natalie Mironov, DO'20<sup>1</sup>, Julie Meachen, PhD<sup>2</sup>, Rachel Dunn, PhD<sup>2</sup>, Candice Cooper<sup>3</sup>, Joshua Lemert, DO'20, MSA'22<sup>1</sup>

<sup>1</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Anatomy, Des Moines University, Des Moines, IA

<sup>3</sup> College of Podiatric Medicine and Surgery, Des Moines University, Des Moines, IA

The scapholunar, a carpal bone formed by the fusion of the scaphoid and lunate bones, is found in a variety of mammals, including carnivores. Given the role of limb bones in locomotion and the lack of previous study on carpal bones, the goal of this study was to determine if the scapholunar could determine locomotor ecology of extinct, Pleistocene carnivores. In this study, we examined fossils of extinct carnivores from Natural Trap Cave (NTC). By assessing fossils from a single locale, we can reconstruct the habitat and ecosystem of NTC. Targeted questions include: were the extinct carnivores found at NTC more adapted for running than their modern-day counterparts, and what does their wrist morphology tell us about the habitat at NTC during the Pleistocene? Extinct species examined include American lion (*Panthera atrox*), American cheetah (*Miracinonyx trumani*), and Beringian wolf (*Canis lupus spp.*). Modern species include gray wolf (*Canis lupus*), lion (*Panthera leo*), cheetah (*Acinonyx jubatus*), puma (*Puma concolor*), and spotted hyena (*Crocuta crocuta*). We generated 3D scans of each bone using a NextEngine laser scanner. Bones were then sectioned into articular surfaces with the adjacent carpals and radius. Measurements were obtained using GeoMagic and Rhino, with analyses completed in SPSS. Results show wolf species found in NTC were morphologically indistinguishable from their modern-day counterparts. Similarly, *Panthera atrox* grouped with *Panthera leo*. However, the most notable difference was the grouping of *Miracinonyx* with *Puma*, rather than *Acinonyx*. Overall, this shows that more work is needed to distinguish functional effects from relatedness.

## Quantification of Optic Nerve and Optic Canal Size

---

**Kathryn Schwalbe, DO'18**<sup>1</sup>, Lauren Butaric, PhD<sup>1</sup>, Todd Yokley, PhD<sup>2</sup>

<sup>1</sup> Des Moines University, Des Moines, IA

<sup>2</sup> Metropolitan State University of Denver, Denver, CO

Transorbital neuroendoscopic surgery (TONES) is becoming increasingly popular since it provides surgeons direct access to pathological regions. TONES has already been determined a safe surgical approach with the potential ability to be used in surgeries that require additional decompression of the optic nerve. Increased knowledge of average optic canal size and optic nerve size will help surgeons and biomedical engineers develop practices and equipment to continue expanding the use of this technique and to minimize the number of adverse events. This study quantifies the size of the optic nerve and compares it to the size of the optic canal using CT scans from Europeans (n=20) and African-Americans (n=10). Regression analyses will be used to compare the size of the optic nerve to the size of the optic canal, while student t-tests will identify potential population differences. Together this data will provide information regarding the standard size of an optic nerve and the proportion of the optic canal area that it takes up between diverse populations. This research will be completed in mid-November 2017 and be ready for the poster presentation at the Des Moines Research Symposium. Following feedback at the symposium, it will be developed into a manuscript for publication submission.

◆ 25 G ◆

## Progress Towards the Natural Product Synthesis of (S)-1-oxocurcuphenol (A Possible Anti-Cancer Agent)

---

**Corey S. Keenan, DO'21** and S. Shaun Murphree, PhD

Allegheny College, Meadville, PA

With the recent isolation of 1-oxocurcuphenol from the marine sponge *Myrmekioderma* elucidating its unique anti-cancer activity against the HT-29 cell line<sup>1</sup>, progress towards the synthesis of this natural product is here within. Two approaches were attempted, one involving the key step of a flavin catalyzed Baeyer-Villiger oxidation and the other proposing a more common Baeyer-Villiger oxidation using *m*CPBA conditions. Use of the flavin catalyst in approach one was sought to provide a chiral synthesis of 1-oxocurcuphenol whereas approach two worked towards the racemic synthesis, ultimately providing progress towards this possible anti-cancer natural product. Further completion of this synthesis is required and currently underway.

◆ 26 G ◆

## Statin Binding Affinity to CYP2D6 Reduced-Function Alleles in Three Populations

---

**Noori Al Kadhim, DO'21** and Haizhen Zhong, PhD

Department of Chemistry, University of Nebraska at Omaha, Omaha, NE

HMG-CoA reductase inhibitors (statins) have long been used for the treatment of hypercholesterolemia and the prevention of coronary artery disease. They are mainly metabolized by cytochrome P450 (CYP) isozymes: a family of hepatic oxidizing enzymes. While most statins have been shown to be mainly metabolized by CYP3A4 and CYP2C9, there has been evidence that metabolism by CYP2D6 mutant variants may account for the variability of drug responses and efficacy cross-culturally. To assess the effect of CYP2D6 on statin efficacy and bioavailability, multiple sequence alignment data of 13 CYP2D6 mutant alleles as well as the wild-type allele mRNA sequences were used to construct a phylogenetic tree and three common reduced-function mutants (CYP2D6\*10, CYP2D6\*17, and CYP2D6\*41) responsible for the intermediate metabolizer (IM) phenotype were selected to test for their affinity to the seven statins currently in use and an additional 55 drugs metabolized by CYP2D6. The reduced-function allele sequences were used to construct homology models based on the wild-type CYP2D6 and their affinity to the 62 drugs were calculated using a Glide docking function. With the exception of simvastatin, the reduced-function alleles had lower docking scores to both synthetic and naturally-occurring statin drugs, indicating lower metabolic activities, although analysis of variance demonstrated that the differences in docking among the tested CYP2D6 alleles were not statistically significant.

## Olfactory Sensory Neurons are More Active in Fmr1 Knock-Out Mice Than in Wild-Type Mice

---

Sakshi Kaul, DO'21, Lauren Kirk, Priscilla Ajilore, Katherine A. Shepard, Michael R. Akins

Biology, Drexel University, Philadelphia, PA

Fragile X syndrome (FXS) is the most common form of inherited intellectual disability and autism. Common presentations include autism, social anxiety, seizures, repetitive behaviors, and sensory hypersensitivity. Sensory hypersensitivity in FXS patients and mouse models has been thought to arise solely from defects in central nervous system processing of sensory information with normal responses in the peripheral nervous system. To investigate this question in the olfactory system, we are asking whether Fragile X mice exhibit increased responses to smells at all levels of the olfactory pathway. Preliminary studies have revealed that, contrary to expectation, the peripheral olfactory sensory neurons are hyperresponsive to smells. Here, we are asking whether this hyperactivation is also present in the olfactory bulb – the first site of olfactory information processing in the central nervous system. To address this question, we are taking advantage of the fact that periglomerular cells in the olfactory bulb express the immediate early gene c-Fos when they are activated in response to a smell. We exposed both wild type and Fragile X mice to odors and asked how many periglomerular cells in each genotype express c-Fos, as compared to control mice of each genotype that did not receive an odor exposure. These studies will illuminate the locus of sensory pathology in Fragile X syndrome and may suggest potential therapeutic strategies.

## Activation of Novel Prodrugs to Combat Herpes Virus Infections

---

Anna Burns<sup>1</sup>, Marc Busch, PhD<sup>2</sup>, Brian Gentry, PhD<sup>1</sup>

<sup>1</sup> College of Pharmacy and Health Sciences, Drake University, Des Moines, IA

<sup>2</sup> Department of Biology, Drake University, Des Moines, IA

Primary therapy options for the treatment of systemic herpes virus infections include acyclovir (ACV), ganciclovir (GCV), and their orally bioavailable prodrugs. However, these drugs suffer from a high incidence of adverse effects and/or due to the prolonged nature of treatment, an increasing incidence of drug resistance. The methylenecyclopropane nucleoside analogs (MCPNAs) are a new class of compounds that demonstrate a greater therapeutic index and a higher barrier to resistance. MBX-2168, a third generation MCPNA, demonstrates a unique mechanism of activation. First, MBX-2168 is phosphorylated, partially or in whole, by the cellular kinase TAOK3. Second, a moiety at the 6-position of the guanine ring is enzymatically removed. While the initial phosphorylation by TAOK3 has been studied and confirmed, examination of the removal of the moiety at the 6-position of the guanine ring of MBX-2168 is in the preliminary stages and needs to be further characterized. Our studies, thus far, have determined that co-incubation with 50 mM pentostatin, an adenosine deaminase (ADA) and adenosine deaminase-like protein-1 (ADAL1) inhibitor, reduces the EC<sub>50</sub> of MBX-2168 by >300-fold (0.02 mM vs. 6.47 mM). Our results also indicate that the moiety at the 6-position of the guanine ring of MBX-2168 is not enzymatically removed by ADA. We therefore hypothesize that the moiety at the 6-position of the guanine ring of MBX-2168 is removed by ADAL-1 following phosphorylation of this prodrug to a monophosphate. Studies confirming the enzymatic removal of the moiety at the 6-position of the guanine ring of MBX-2168-MP are currently on-going.

## **Fabrication of 3D Printed Suppositories for Individualized Drug Delivery: Evaluating Potential Polymers and Software**

---

**Andre Do** and Abebe Mengesha, PhD

College of Pharmacy and Health Sciences, Drake University, Des Moines, IA

The world of 3D printing is continuously expanding upon the development of pharmaceutical dosage forms. This area is important when designing and producing personalized medicine for patients with additional conditions. This work focuses on obtaining potential drug-polymer matrices suitable for 3D printing as well as evaluating software for optimal drug development.

Models of various rectal suppositories were designed by multiple computer aided design (CAD) software (TinkerCAD and Fusion 360) and produced by fused deposition modeling (FDM). Each software was evaluated in terms of difficulty level and functionality to determine their application in a clinical setting. There were favorable benefits found when using TinkerCAD compared to Fusion 360, and therefore, was used towards the creation of a 3D printed dosage form similar to a rectal suppository.

Thermal analysis by digital scanning calorimetry (DSC) was used to assess the melting points of different polymers (Polyethylene-Polypropylene glycol and Poly(acrylic) acid) to determine 3D printer compatibility. The temperature dependent phase transition and the heat of fusion were used to evaluate suitable polymer characteristics for 3D printing.

The sample models used PLA (polylactic acid) filament and were customized to different shapes and sizes. The PLA filament is not pharmaceutically approved for drug development and would require suitable polymers (excipients) for 3D printed drugs. The different sizes and shapes of the 3D printed samples depict the potential for individualized therapy in a clinical setting. This project will supplement current studies in the future development of 3D printed medicine to meet the desired needs of the patient.

## **Identifying Substandard Medications in Developing Nations**

---

**Esad Omanovic**, Jordan Donels, Justin Trier, Alli Thomsen, Julia Dollen, Austin Miller, Nejla Memic, Corbin Zea

Grand View University, Des Moines, IA

Access to adequate and quality health care is a worldwide concern. Without proper access to medicine individuals will often suffer diseases that could be treated or prevented with the proper medicine. Proper dosage is also necessary so that patients can recover from the disease as well as stop the production of drug resistant bacteria and parasites. In collaboration with Norte Dame University, a protocol, using High Performance Liquid Chromatography (HPLC), was developed to quantify the amount of Albendazole, a deworming medication, in tablets from locations in Africa to ensure proper dosage. A Spike and Recovery, a secondary verification method, was developed to verify the efficiency of the column and protocol used. Optimization of the Spike and Recovery method was completed and showed that the efficiency of the column was  $97 \pm 1$  %. Using this protocol, multiple samples have been quantified with one sample falling below the advertised dosage.

## Renal Cell Carcinoma: A Rare Case of Ureteral Metastasis and a False Negative Biopsy

---

Alexander Zhu, DO<sup>1</sup>, Siwei Dong, DO<sup>1</sup>, Matthew Fabiszak, DO<sup>2</sup>

<sup>1</sup> Des Moines University, Des Moines IA

<sup>2</sup> Mercy Medical Center, Des Moines IA

**Introduction:** Renal cell carcinoma (RCC) is the most common primary renal cancer in adults. It is a malignant adenocarcinoma of the renal tubular epithelium and represents 2% of all cancers. Approximately one-third of RCC patients have metastatic disease at initial diagnosis, although ureteric metastasis are a rare finding, with less than 50 reported cases to date.

**Case Presentation:** 67-year-old male presents with oliguria, lower extremity edema, and sudden weight gain. Although he had no prior history of kidney disease, his labs reveal elevated creatinine (8.9) and hyperkalemia (5.6) consistent with acute kidney injury. Renal biopsy demonstrates acute tubular necrosis, likely secondary to chronic NSAID and ARB use.

One month later, patient presents again with intermittent hematuria. CT reveals tissue in renal pelvis suspicious for neoplasm, non-calcified nodule in lung, and enlarged lymph nodes throughout the abdomen. Cystoscopy shows sloughed tubular structure consistent with necrotic ureter. Biopsy of the tissues is negative – revealing necrosis with no evidence of malignancy.

Two weeks later, patient presents again with dyspnea, hemoptysis, fatigue, and WBC of 50.4. PET-CT and CT biopsy reveals stage IV RCC with diffuse metastatic disease to bone marrow, lymph node, lungs, pleural cavity, and soft tissue.

**Conclusion:** Renal Cell Carcinoma is well known for its unpredictable presentation. In fact, the “classical” triad of hematuria, flank pain, and flank mass only occurs in 10-15% of patients. Thus, a high index of suspicion for RCC must remain even in the presence of rare ureteral metastasis or a false negative biopsy.

## Large Pericardial Effusion Mimicking TB Pericarditis

---

Nikhut Siddique, DO<sup>1</sup> and Jeffrey Ziffra DO<sup>2</sup>

<sup>1</sup> Des Moines University, Des Moines, IA

<sup>2</sup> Mercy Medical Center North Iowa, Mason City, IA

Pericardial effusions are a common finding in clinical medicine. Although there have been few large studies that report the incidence, it is known that pericardial effusions are present more than clinically evident. The challenge in diagnosing a pericardial effusion is associating an etiology with it. A thorough history is crucial in associating a likely cause of a pericardial effusion. Any condition that affects the pericardium itself can lead to this condition. Pericarditis (viral, bacterial, TB), myocardial infarction, cardiac surgery, malignancy, or other systemic illnesses are all known causes. Various studies have shown different distributions of the causes of pericardial effusions, although numerous studies have shown acute idiopathic pericarditis as the leading cause regardless of the presence of cardiac tamponade. Hemorrhagic pericardial effusions have an even different distribution of causes, however malignancy and tuberculosis in endemic areas are very common. It is important to establish the presence or absence of cardiac tamponade with pericardial effusions. Cardiac tamponade is highly suggestive with the presence of a pericardial effusion on echocardiogram with evidence of cardiac chamber collapse, flow variation, and IVC dilation. Other clinical findings include hypotension, JVD, pulses paradoxus, and distant muffled heart sounds. Treatment of pericardial effusion includes management of the underlying disease if an etiology is established. Diagnostic and therapeutic pericardiocentesis is usually performed. Fluid cultures and diagnostic testing is performed to check for the presence of infection, TB, systemic diseases, or malignancy. However as in our case, many times there is no conclusive etiology found.

## Assessing Male Pelvic Floor Dysfunction Using Ultrasound Imaging: A Literature Review

---

Kathryn Estes, DO<sup>201</sup>, Kari Smith, DPT, BFB-PMD<sup>2</sup>, Catherine Stevermer, PT, PhD, GCS<sup>2</sup>

<sup>1</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> College of Health Sciences, Des Moines University, Des Moines, IA

Ultrasound is a safe and noninvasive way to visualize anatomical structures of the male pelvic floor. Although its various uses have not been well studied in regards to male pelvic floor muscles, this review aims to make conclusions about how ultrasound can be used to assess and treat dysfunctions of the male pelvic floor, specifically urinary incontinence. Muscles that affect continence include the levator ani, striated urethral sphincter and the bulbospongiosus. Ultrasound assessment of the pelvic floor has been found to be a reliable method for measuring changes in anatomical features during pelvic floor movements. Differences in these muscles and their function have been seen on ultrasound between men with and without urinary incontinence. Ultrasound can also be used to clarify and classify a diagnosis by gaining information about the specific anatomy in that area. Current literature suggests ultrasound imaging, for the purpose of biofeedback, is beneficial for rehabilitation to identify and improve motor recruitment of the puborectalis, bulbospongiosus and striated urethral sphincter. Although the use of ultrasound to assess pelvic floor muscle strength has been hypothesized, literature suggests it is not a successful method to assess muscle strength despite visualization of specific muscles. Ultrasound can assess many aspects of anatomy and function of the pelvic floor, and it can assist in making decisions about treatment options and classifying diagnoses. Transperineal ultrasound aids to create a specific and reliable diagnosis of muscle dysfunction and can assist in biofeedback which is helpful for treating urinary incontinence.

◆ 34 UG ◆

## Analysis of Publications and Funding for a Small Health Sciences University Over a Three-Year Period

---

Kieran Severa<sup>1</sup>, Mollie Lyon<sup>2</sup>, Jeffrey Gray, PhD<sup>2</sup>

<sup>1</sup> Drake University, Pharmacy and Health Sciences, Des Moines, IA

<sup>2</sup> Office of Research, Des Moines University, Des Moines, IA

**Background:** Des Moines University (DMU) is a small health sciences university that has experienced notable research growth over the past several years. The purpose of this project is to evaluate the number of papers, books, grants submitted, grants funded, and presentations that have been completed by the DMU campus to further identify strengths and opportunities in the future.

**Methodology:** The materials of this review included 775 outcomes published by the DMU research community in the years of 2014, 2015, and 2016. Outcomes were sorted into 9 categories; Cardiovascular, Movement Science, Public Health, Pedagogy, Anthropology/Paleontology, Clinical, Cancer, Biomedical, and Miscellaneous and was data analyzed. It is important to note that some outcomes can appear in multiple categories, I.E. A peer reviewed paper could be both movement science and clinical research.

**Results:** In categories of peer reviewed papers, grants submitted, and grants funded, biomedical research had the most outcomes with clinical research products being the second most common. Biomedical, pedagogy, cancer, and public health research all showed increasing trends in peer reviewed papers. Movement science, cancer, and public health research all showed increases in grants, both submitted and funded.

**Discussion:** One challenge of a quantitative analysis of funding between categories is the data indicates the number of grant submitted and funded but not how much funding was awarded. Therefore, in many cases data aggregation can omit key details regarding outcomes and can result in skewed data.

## Effect of Participation on a Short Term Medical Service Trip on Cultural Competence in Health Care Professional Students

---

Michelle Mages<sup>1</sup>, John Rovers<sup>1</sup>, Michael Andreski<sup>1</sup>, Jeffrey Gray, PhD<sup>2</sup>

<sup>1</sup> Drake University, Des Moines, IA

<sup>2</sup> Des Moines University, Des Moines, IA

Health care professional students often participate in medical service trips (MSTs) to underserved areas. Such trips can be expensive and are rarely formally evaluated. Despite lack of evidence, participation on MSTs may be justified if it enhances students' cultural competence. This study evaluated the effect of participating on a MST on students' cultural competence.

Students from two universities participated on two different MSTs in spring 2017. Students were requested to complete electronic QUALTRICS surveys before and after the MSTs. Surveys collected demographic data and included the Inventory for Assessing the Process of Cultural Competence Among Healthcare Professionals – Student Version (IAPCC-SV). The IAPCC-SV is a validated instrument designed for use in health professions students that measures cultural competence.

The survey yielded 26 useable responses both pre- and post-trip. Participants' average age was 25 years and the following programs were represented: Doctor of Osteopathic Medicine (n=19); Doctor of Podiatric Medicine (n=4); Doctor of Pharmacy (n=2); and Physician Assistant Studies (n=1). Fifteen students had previously participated on MSTs. The average change in IAPCC-SV total score from pre- to post-trip was 4.92, which was greater than the minimum detectable change (MDC) of 4.10. Changes greater than the MDC were also seen in average score for two subscales: knowledge and skills.

This study serves to evaluate effect of participation on MSTs on health care professional students. Students experienced a measurable increase in overall cultural competence and two subscales after participating. We conclude that students on MSTs benefit by having an increase in cultural competence.

## Faculty Perceptions of a Piloted Curriculum Mapping Experience

---

John Kim, DO'20 and Leslie Wimsatt, PhD

College of Osteopathic Medicine, Des Moines University, Des Moines, IA

**Background:** Given the rapid growth in medical knowledge, many medical schools have employed curriculum mapping to support the integration of multiple courses into cohesive curricula with “smooth transitions between.”<sup>1</sup> While research identifies several benefits of curriculum mapping, including transparency in planning and interconnectedness of course content, very few studies approach curriculum mapping through the lens of faculty involved in the mapping process. The goal of this research is to explore faculty perceptions of a mapping process, with attention to factors that facilitated and/or created barriers to faculty involved with the course mapping work.

**Methods:** Our exploratory research adopted semi-structured interviews as the method of data collection to gain insight into mapping perceptions. Using PubMed search terms (e.g., “curriculum”, “map”, “mapping”, “faculty”, “perception”, “outcome”), a literature review was undertaken to design questions focused on osteopathic competencies, core content, “collaboration and collegiality among faculty members,”<sup>2</sup> and administrative support and personal satisfaction.<sup>3</sup> The 16-item interview protocol was formatted to allow flexibility and freedom to our participants and provide an opportunity to “share their perceptions”<sup>4</sup> of the mapping process. Participants include six preclinical faculty members from Des Moines University, College of Osteopathic Medicine, who were extensively involved in curriculum mapping in 2016-17. Between November 2017 and March 2018, participants are taking part in individual 30-60 minute interviews in their offices. Interviews are recorded, then later transcribed and analyzed based on recurring themes, interconnectedness, and individual emphasis areas.<sup>5</sup>

**Results:** Pilot testing of the interview protocol was undertaken. Preliminary interview results are reported thematically.

## Practice Makes Perfect: What Does It Take to Perform Better in Medical Pharmacology at DMU?

---

**Matt Henry, PhD**

Department of Physiology and Pharmacology, Des Moines University, Des Moines, IA

The Medical Pharmacology course at DMU implemented an assessment strategy aimed at improving student performance. Each unit in the course is followed by a summative assessment and the course culminates with a comprehensive exam. Student performance on this comprehensive exam is low (62-67%) despite relatively high performance on the unit tests (86-91%). In 2016, the course attempted to improve student performance by offering a formative assessment strategy that allowed for the practice of lower order, foundational questions until mastery was achieved. It was hypothesized that offering formative assessments would improve performance in the course. The DO18 class completed the course in 2015 and serve as a control group (CTRL). The DO19 class completed the course in 2016 with formative assessments and serve as the treatment group (TRMT). A significant difference was observed between the CTRL and TRMT groups on exams and individual test items (t-test,  $p < 0.05$ ). Further, difficult test items completed by the TRMT group demonstrated a large shift in performance when measuring the Effect Size (Cohen's Standard,  $d = 0.957$ ). Analysis demonstrated that students in the TRMT group that achieved a grade greater than an 'A' on the formative assessments performed better on the course summative exams as compared to students that did not work toward mastery and scored a grade below 'B' (ANOVA on ranks). These findings support the use of a repetitive formative assessment strategy to improve student learning outcomes and can be used when counseling students on strategies to improve their course performance.

## Effectiveness of Two Different American Heart Association Basic Life Support Educational Designs on Learner's Foundational Basic Life Support Skills Quality

---

**Shelley L. Oren, MS<sup>1</sup>**, Gavin Gardner, MA.Ed.<sup>1</sup>, Gregory Kolbinger, MPAS, PA-C<sup>2</sup>

<sup>1</sup> Simulation Center, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Family and Internal Medicine, Des Moines university, Des Moines, IA

Recent evidence suggests that basic life support (BLS) delivered during cardiac arrests in hospitals are of variable quality, and that poor quality contributes to poor patient survival, a preventable harm to patients. The key element underlying the quality of resuscitation is the effectiveness of resuscitation education (Hunt, et al; 2008). Thus, there is a need to determine which American Heart Association (AHA) educational design will provide learners with the highest resuscitation skills. The two educational designs compared in this study were Heartcode BLS (HC; designated as Design # 1) versus Instructor led practice while watching (IL-PWW; designated as Design # 2). BLS skills performance quality was objectively quantified via a special manikin (QCPR) immediately following each educational design. HC students (n=117) scored average 80.5% in overall BLS skills quality, exceeding the 75% "Passing" benchmark, while IL-PWW students (n=93) scored average 70.5%, below the benchmark. These results indicate HC may be a superior educational design for immediate BLS skills quality. However, there are three concerns with these BLS quality measures. One, the lower than expected quality immediately after class in both designs; two, the wide range of BLS quality across individual students: +/- 16.2 % (HC) and 24.6% (IL-PWW) and third, retention of skills. While immediate post skills were higher in HC students, it is possible students will retain less information and end up (in the long term) remembering less than your initially less productive model. These concerns may indicate that repeated exposure to skills practice may be as important as educational design to high quality BLS skills.

Hunt, E. A., Fiedor-Hamilton, M., & Eppich, W. J. (2008). Resuscitation education: Narrowing the gap between evidence-based resuscitation guidelines and performance using best educational practices. *Pediatric Clinics of North America*, 55(4), 1025-50, xii. doi:10.1016/j.pcl.2008.04.007 [doi]

## Using Science Kits to Bring The Fun Back Into High School Anatomy and Physiology Class

---

**Sandy Le<sup>1</sup>**, Tiffany LeMaster<sup>1</sup>, Kacia Cain<sup>1</sup>, Kathleen Bitterman, BS<sup>2</sup>, Muhammad A. Spocter, PhD<sup>2,3</sup>

<sup>1</sup> Des Moines Public Schools, Central Campus, Des Moines, IA

<sup>2</sup> Department of Anatomy, Des Moines University, Des Moines, IA

<sup>3</sup> School of Anatomical Sciences, University of the Witwatersrand, Johannesburg, Republic of South Africa

High school anatomy and physiology courses are traditionally centered around a series of instructor-directed lectures with limited dissection opportunities and very little active learning. Here we describe the use of two in-class experiments that could be used to enhance student learning about neuroscience and help facilitate the construction of science projects for high school juniors and seniors. Using a project-based learning approach, students were asked to work in teams and design an experiment which uses components of the Backyard Brains toolkit (i.e., Roboroach and/or SpikerBox) to help educate the public about the nervous system and anatomy. High school students participating in this program were drawn from an existing collaboration with Des Moines Public Schools Central Campus and worked over a three-week period on the design and implementation of the experiments. We demonstrate that the use of hands-on science kits is a cost-effective way to help build active learning components into the high school anatomy and physiology classroom.

## Analysis on Vision Screenings of Daycare and Elementary Children in the Des Moines Metropolitan Area with Waukee APEX and Prevent Blindness Iowa

---

**Kaitlyn Harris<sup>1</sup>**, Holly Showalter, PhD<sup>1</sup>, Jeanne Burmeister<sup>2</sup>

<sup>1</sup> Waukee APEX, Waukee High School, Waukee IA

<sup>2</sup> Prevent Blindness Iowa, Des Moines, IA

We examined vision screening results of daycare and elementary school children in the Des Moines metropolitan area. Waukee APEX Associates were certified to screen the children and as a result gathered teams and independently screened children to report to Prevent Blindness Iowa (PBI). A series of vision screenings were done with children depending on age to determine whether or not their ability to read vision charts met the age standard. Associates at Waukee worked with PBI to report the final results and help detect early signs of vision impairment in an effort to identify and refer children to optometrists. The overall goal of this project was to raise awareness of early childhood blindness and perform screenings on behalf of PBI to reach more children in the Waukee area specifically. In the 2016-17 academic year, a total of 1,249 children were screened by APEX Associates. Of those 1,249 students, 65 were referred to an optometrist. From this project, Associates developed professional skills such as complex communication, detail orientation, and bedside manner. Waukee Associates continue to work with PBI to screen children every semester.

## Zika Virus Knowledge, Education, and Contraceptive Use Among Rural Dominican Republic Communities

---

**Shant Adamian, DO'19<sup>1</sup>**, Sarah Andres, DO'19<sup>1</sup>, **Brooke Bachelor, DO'19<sup>1</sup>**, Elizabeth Baker, PhD<sup>2</sup>, **Fiona Hodges, DO'20<sup>1</sup>**, **Tricia Mittra, DO'19<sup>1</sup>**, Rebecca Shaw, MD<sup>3</sup>

<sup>1</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> College of Health Sciences, Des Moines University, Des Moines, IA

<sup>3</sup> Department of Specialty Medicine, Des Moines University, Des Moines, IA

**Introduction:** Amidst the Zika virus epidemic, a team from Des Moines University traveled to four rural communities surrounding Monte Cristi, Dominican Republic to provide health services. The team assessed Zika virus knowledge, common contraceptive methods, and current methods of disseminating vital health information over a period of four days.

**Methods:** Ninety men and women provided informed consent to participate in a 12-question, verbally administered survey.

**Results:** Most participants had heard of Zika virus and had received their information from *charlas*, a local term for informal health presentations. Few knew that Zika is present in their communities, can be sexually transmitted, and is incurable. The most commonly cited contraceptive method was condoms, and thirty percent of participants did not use contraception. One patient reported long-acting reversible contraceptive (LARC) usage.

**Conclusion/Implications:** Significant Zika knowledge deficits were present within these communities and accurate knowledge varied. Through identification of specific knowledge gaps, communities can disseminate standardized, unambiguous, and realistic recommendations to prevent infection during similar epidemics. Additionally, the limited usage of LARCs appeared, anecdotally, to be due to lack of access, rather than lack of desire for LARCs. This is particularly concerning in an environment where pregnancy prevention is the primary recommendation to prevent fetal harm. Future research should analyze *charlas* to identify the most effective methods for disseminating critical information in a timely manner to similar populations. In the context of inevitable future epidemics, results may not only be applicable to Dominican communities, but to rural communities globally.

## Climate Change and Preparedness for Future Pandemics, Case Study: Zika Virus

---

**Shant Adamian, DO'19<sup>1,2</sup>** and John Balbus, MD, MPH<sup>2,3</sup>

<sup>1</sup> Des Moines University, Des Moines, IA

<sup>2</sup> United States Global Change Research Program, Washington, DC

<sup>3</sup> National Institute of Environmental Health Services, Bethesda, MD

Vector borne diseases have threatened human health for centuries. Many factors play a role in the transmission of disease by vectors, but one significant factor is the impact of climate change on the proliferation of future pandemics. In 2015, an El Nino-Southern Oscillation pattern assisted in the development of ideal temperature conditions for the spread of Zika virus in the tropics through the *Aedes* mosquito. This climate event preceded the 2015-2016 Zika virus Pandemic.

Zika virus transmission can be vector-borne, sexual, or vertical. The combination of these modes of transmission, along with increased global travel and habitat modification through climate change, make the occurrence of future viral vector-borne diseases more likely, and even more problematic for human populations. Data from the 2016-2017 United States Zika Virus Registry demonstrate the significant economic, social, and healthcare burden caused by a single vector-borne illness. The outcomes from the Zika virus pandemic supports the need for the development of a coordinated effort between the atmospheric and health communities in order to mitigate the spread of disease.

Through the collection of accurate vector and disease data, development of reliable climate modeling and early warning systems for predicting climate patterns that precipitate the spread of disease, novel vector control interventions, and strong public health education, agencies can work together so that the United States is prepared for the next vector-borne pandemic.

## Strengthening Health Care Infrastructure Post USSR: A Comparative Analysis of Post-Soviet States

---

**Nelli Ghazaryan, DO'21<sup>1</sup>**, Pierre Vigilance, MD, MPH<sup>1</sup>, Simon Geletta, PhD<sup>2</sup>

<sup>1</sup> George Washington University, Washington, DC

<sup>2</sup> Des Moines University, Des Moines, IA

Since the fall of the Soviet Union, many of its former States have undergone economic, political, and social reforms to varying degrees. In an effort to move away from the once centralized system, changes were implemented to trade, policy, and health care infrastructure. This comparative study of Armenia, Belarus, and Georgia aims to understand the path of health care reform in each country over the last 25 years and the varying degrees of success they have had across the arena. This transition away from a centralized power and the fight to establish a new public health system can provide lessons for countries currently in transition. The barriers faced and overcome can provide solutions to current issues. Overall, the study of the process undertaken by the former Soviet states can enrich our understanding of what it means to rebuilt infrastructure in a climate of scarcity.

A shared Soviet history, similar population size, and social and religious similarities allow for comparison and opportunities for learning. Armenia, Belarus, and Georgia are all lower middle income countries, as such, gaining access to adequate medical care is prohibited by cost for many citizens. In Belarus, which rejected rapid economic reforms, people are able to obtain health care without great difficulty. By contrast, for those living in Armenia and Georgia, which in addition to more severe economic collapse, experienced major armed conflicts, the systems are not faring as well.

In addition to the approaches taken by the governing bodies to rebuilding of physical and governmental infrastructure, there are cultural differences to consider. While some differences in health-seeking behavior are to be expected due to cultural norms and attitudes shaping the way people interact with the health system, <50 percent of those reporting illness in Armenia and Georgia sought care. In studies conducted by the WHO, UNHCR, and independent international researchers, cost is most often cited as the reason for not seeking health care. Most respondents who did obtain care made out-of-pocket payments, raising the cost of care even in a system with free healthcare. Those who needed care were unable to obtain it and, when they were, largely paid out of pocket. Out of pocket (OOP) payments currently make up over half of the total health expenditure in Armenia and Georgia, while Belarus has universal health care coverage for all its citizens with minimal out of pocket spending. Additional considerations include distribution of health care workforce between urban and rural areas, graduate medical training, and strength of primary care systems.

## Changes in the Ambulatory Care Visit Patterns Among Iowa Hospitals

---

Alexandra Halbach, DO'20 and Simon Geletta, PhD

Des Moines University, Des Moines, IA

**Background:** A number of studies that focused on hospital visit patterns have shown that patients sometimes choose to bypass local facilities for distant ones. Some studies highlight that bypass visits are indicative of a healthy “referral process” in which smaller rural facilities treat patients locally for most medical conditions, but refer them to larger treatment centers for conditions that are “beyond the scope of general medical or surgical treatment” (Radcliff et. Al., 2003). Others have argued that bypass visits are motivated by rural residents’ (negative) perception of their local care centers (Liu et. Al., 2008). Such studies have emphasized that bypass visits contribute to the loss of market share for the local hospitals (Williamson et. Al., 1998), and as such, pose threats to the financial viability of small rural hospitals (Escarse and Kapur, 2009).

**Purpose:** The objective of this study is to investigate the prevalence and trend of hospital bypass visits in Iowa. We used Iowa Hospital Association data to calculate the rate of bypass visits in 2013 and 2016.

**Methods:** This study used the county-hospital origin-destination reports to distinguish local visits from bypass outpatient visits to Iowa hospitals. The rate at which bypass visits occurred at each hospital, including the 86 critical access hospitals in the state. This is then aggregated to determine the statewide incidence of bypass visits.

**Findings:** The study demonstrated that in 2013, the percentage of bypass visits was 31.8% among all Iowa hospitals, and 23.9% among Critical Access Hospitals. In 2016 the bypass visits rate of 29.2% is observed among all Iowa hospitals and 25.2% among CAHs.

**Conclusion:** The observed prevalence of bypass visits among Iowa hospitals are typical with previous national estimates. For example, Radcliff et. al. (2003), estimated a bypass rate of 30% among the seven states that they investigated and Liu et. al. 2008), reported an overall bypass rate of 32% for nationwide hospitals. The fact that there has been a decrease in the rate of bypass visits among all hospitals and a slight increase among the CAHs has not been documented by other studies.

## Assessing the Use of the IPOST at Admission to the Emergency Department

---

Lindsey Harrison, BS<sup>1</sup>, Emilie O'Connor, BS<sup>1</sup>, Catherine Hackett Renner, PhD<sup>2</sup>, Nicholas Kluesner, MD<sup>2</sup>

<sup>1</sup> Des Moines University, Des Moines, IA

<sup>2</sup> UnityPoint Health System, Des Moines, IA

**Introduction:** When patients arrive in the Emergency Department (ED) for care, their wishes regarding life-sustaining treatment are often unknown. To address this issue, Iowa created the *Iowa Physician Orders for Scope of Treatment* (IPOST), a one-page document designed to outline the patient's end-of-life care goals. Unfortunately, patients often arrive in the ED without an IPOST. We sought to investigate the incidence of patients 65 years and older arriving with a valid IPOST.

**Methods:** We performed a retrospective chart review of 40 patients with ED visits in 2017, then added a prospective study arm in which patient documents were examined for the presence of an IPOST upon arrival in the ED. Fourteen Des Moines area care facilities were also asked to complete a survey.

**Results:** 119 patients were included, with only 9 patients arriving with their completed IPOST. We found that very few Des Moines area care facilities had an actual IPOST requirement for their residents and less than half had 50% or more of their residents with a completed IPOST.

**Conclusion:** Our data and experiences have identified a significant gap in the number of elderly patients in the Des Moines area with a valid IPOST. These data suggest either that IPOST's are not by utilized by the population, or that they are being completed but not accompanying the patient as intended. Our future directions include educating the community on the IPOST and its uses at the levels of primary care, EMS, and extended care facilities.

## Evaluation of the Emergency Department Fast Track to Reduce Patient Length of Stay

---

Sophia Hackman, DO<sup>19</sup>, MPH<sup>21</sup>, J. Mark Wise<sup>2</sup>, Clint Hawthorne, MD<sup>2</sup>, Natalie Chadwick, PA-C<sup>2</sup>

<sup>1</sup> Des Moines University, Des Moines, IA

<sup>2</sup> UnityPoint Health Des Moines, Des Moines, IA

Fast track (FT) areas of the Emergency Department (ED) have been utilized to decrease length of stay (LOS). One concern with FT is that it may increase the LOS for higher complexity patients. The purpose of this study was to evaluate the LOS difference for acuity level 3, 4, and 5 patients during days when the FT was staffed versus when it was unstaffed. A retrospective chart review of ED timeline flowsheets was performed. Data recorded included patient and provider demographics, whether the patient was roomed in FT or in the ED, arrival time, room time, and discharge time. We calculated LOS from arrival time to discharge time.

While the FT was unstaffed, the LOS for level 3, 4, and 5 patients was 3:16 hours. While it was staffed, the LOS was 3:01 hours, a 15 minute decrease ( $p=0.02$ ). While the FT was unstaffed, the LOS for level 4 and 5 patients was 2:31 hours. While it was staffed, the LOS was 2:01 hours, a 28 minute decrease ( $p=0.0008$ ). While the FT was unstaffed, the LOS for level 3 patients was 3:37 hours. While it was staffed, the LOS was 3:30, a 7 minute decrease. The LOS for level 3 patients was not statistically different, showing that FT does not increase their LOS. With a 28 minute decrease in LOS for acuity level 4 and 5 patients, we are able to see 8 more patients per day in our 4 bed FT.

## Contextual Care in Health Outcomes: A Systematic Review of Reviews

---

Satvika Mikkilineni, DO<sup>20</sup><sup>1</sup> and Jeritt Tucker, PhD<sup>2</sup>

<sup>1</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Behavioral Medicine, Medical Humanities, and Bioethics, Des Moines University, Des Moines, IA

Recent reviews suggest that contextual aspects of patient-provider relationships (sometimes referred to as *cognitive* and *emotional* aspects of care) have an important impact on health outcomes regardless of the specific treatment provided. Given the plethora of existing reviews, a systematic review of reviews is needed to compare and contrast these analyses and provide decision-makers with clear guidance. The present study sought to systematically evaluate current reviews of contextual care in order to identify the variety of contextual interventions, their proposed mechanisms of change, and their myriad impact on consequential health outcomes.

Data sources included the Cochrane Database of Systematic Reviews, U.S. National Library of Medicine National Institutes of Health, MEDLINE Complete, Cochrane Central Register of Controlled Trials, Database of Abstracts of Reviews of Effects, ACP Journal Club, HS Economic Evaluations Database, Academic Search Elite, CINAHL Plus with Full Text, Global Health, Health Technology Assessment, PsycINFO. Grey literature sources included American Doctoral Dissertations, Newspaper Source Plus, and Newswire. The search terms used for the present review were derived from an iterative, three-step process.

This search process produced 5,507 potentially relevant articles, 3,230 articles (58.7%) remained after removal of duplicate records. Inclusion criteria were any review articles which examined at least one contextual intervention related to the patient-provider relationship in a clinical population with a physical illness. Data extraction is ongoing. At the present time, 396 articles have been reviewed using inclusion and exclusion criteria. Of these, 56 (14%) full-text works were determined eligible. Results will summarize the quality of the reviewed articles and their primary findings, with implications for clinical practice and medical education discussed.

## Quality Measurement by Medicare Physicians in Urban and Rural Areas in 2016

---

**Tami Swenson, PhD**

Des Moines University, Des Moines, IA

Physician payment reform efforts, including Medicare initiatives, are developing ways to reimburse physicians that focus on quality of care rather than quantity of services. Quality measurement is instrumental to determining value-based payments, but the measurement of physician quality is complex given the variation in physician services and practices. Medicare physician quality measurement and value-based payment reform has been an incremental transition from financial incentives and penalties for reporting quality measures, to public-reporting of quality measures for large physician practices for a value-based payment modifier, and, currently, to quality payment models that scale volume-based physician payments. Using the Medicare Physician Compare Database, this study examines quality reporting rates by urban and rural physicians for participation in Medicare incentive payment programs in 2016. The findings show that overall rates of quality reporting incentives in 2016 are higher for physicians (57.1%) in metropolitan areas than rural practices in micropolitan (53.5%) and noncore (49.0%) areas. For primary care physicians and small-sized physician practices (2-25 MDs/DOs), non-core practices (44.2% primary care; 40.1% small-sized) lag behind their comparable counterparts in metropolitan and micropolitan areas (54.1% overall for primary care; 46.9% overall for small-sized practices). The implications of these trends suggest that rural physician practices are at risk for financial penalties due to lack of quality reporting participation.

## Interventional Pain Procedure Trends by Medicare Providers

---

**Tami Swenson, PhD**

Des Moines University, Des Moines, IA

Chronic pain affects both the quality of life of individuals and their families and imposes an economic burden on society through lost productivity and public and private health care expenditures. The Institute of Medicine estimates about 100 million Americans are affected by chronic pain, more than those affected by heart disease, diabetes and cancer combined, and pain-associated economic costs reach approximately \$600 billion per year. Procedures commonly used to treat chronic pain include temporary pain relief from nerve root blocks, epidural injections, and joint injections to more long term and invasive therapies, such as neurolytic nerve destructions, radiofrequency ablation, and ambulatory surgical procedures on the spinal column or disc. Using the Medicare provider summary data, trends in the administration of interventional pain procedures are examined for physicians and advance practice registered nurses (APRNs). As the population ages, the geographic distribution of the supply of health care providers to address health care issues of chronic pain will need to be monitored for patient access. The findings from this analysis may be used to track those changes to monitor practice patterns and patient populations. Specifically, the analysis highlights regional differences in access to pain providers and the potential limitations of using administrative claims to identify chronic pain procedures and rendering providers.

## Effect of Tai Chi on Stiff Knee Gait Post Total Knee Arthroplasty

---

**Kristina A. Sturdevant**, Chaston R. Pola, DPT'19, Kathy L. Mercuris, PT, DHS

Department of Physical Therapy, Des Moines University, Des Moines, IA

**Introduction:** Stiff knee gait is defined as  $\leq 10^\circ$  difference between knee extension at heel contact to foot flat during gait after a total knee arthroplasty (TKA). Additional gait changes and functional activity limitations, including fall risk, may occur. The purpose of this study was to determine the effect of Tai Chi for Arthritis and Fall Prevention (TCAFP) on stiff-knee gait and function following TKA surgery.

**Subjects:** Sixteen participants (10 female); community volunteers post-TKA surgery 4.03 years (SD  $\pm$  7); mean age 72 years (SD  $\pm$  8).

**Materials/Methods:** Strain gauge measured joint angles to determine knee stiffness during ambulation forward and backwards on the Zeno® electronic mat. Participants completed a WOMAC questionnaire, 30 Second Sit to Stand (30STS), Timed Stair Climbing Test (TSCT), Single Leg Stance (SLS), and passive range of motion (PROM) for extension and flexion of the affected knee. Participants attended TCAFP classes 3x/week for 10 weeks.

**Results:** The Wilcoxon Signed-rank data revealed significant ( $p \leq 0.05$ ) improvement in knee flexion and extension PROM, 30STS, and decreased TSCT, all with large effect sizes.

**Discussion:** Benefits in function and PROM following TCAFP practice in subjects post-TKA with stiff knee gait are evident through quantitative clinical measurements. SLS and WOMAC did not show any difference pre to post. Additional gait analysis is in process.

**Clinical Relevance:** Patients with a stiff-knee gait following a TKA can benefit from using TCAFP to improve PROM, and activities of daily living such as sit-to-stand, stair use, and balance. TCAFP is a gentle, low impact, and adaptable exercise program.

## Neck Pain: A Feature of Sinus Headaches

---

**Laura Burton**, DPT'18 and Shannon Petersen, PT, DScPT, OCS, FAAOMPT, COMT

Doctor of Physical Therapy Program, Des Moines University, Des Moines, IA

Individuals with chronic headaches often exhibit signs and symptoms of multiple headache types, making diagnosis and intervention challenging. Because the trigeminal system innervates both the sinuses and neck, overlapping presentations may occur in patients with sinus headaches (SH) and cervicogenic headaches, which originate in the neck. Furthermore, patients who incorrectly self-diagnose SH may take over the counter (OTC) medications which are not indicated. The purpose of this study was to determine if individuals with SH also report neck pain (NP). A secondary purpose was to determine usage of self-prescribed medications.

Thirty-one subjects with self-diagnosed SH participated. Subjects answered questions regarding the presence of NP and NP behavior. They also answered questions regarding OTC allergy and sinus medication usage and effectiveness.

NP was reported by 83.9%(26) of subjects; of whom 80.8%(21) reported NP spreading to their headache area. Headaches were aggravated by neck movement in 58.1%(18) of subjects and by sustained postures in 51.6%(16). Allergy and sinus medication use was equally reported at 74.20%(23) for each; allergy and sinus medications were moderately effective for 69.6%(16) and 78.3%(18) respectively, and very effective for 4.4%(1) for both.

Individuals with SH report NP that relates to their headaches. Although some relief with allergy and sinus medication was reported by over half of the subjects, it is possible that some have co-existing cervicogenic and SHs. Further investigation is warranted to clarify if musculoskeletal neck dysfunction is a contributing factor to SH. This may have clinical implications for addressing impairments associated with both headache types.

## Cervical Pain Threshold and Quality of Life Impairments in Subjects with Sinus Headaches

---

**Daniel Larson, DPT'18**, Laura Burton, DPT'18, Carrie Nelson, DPT'19,  
Shannon Petersen, PT, DScPT, OCS, FAAOMPT, COMT

Doctor of Physical Therapy Program, Des Moines University, Des Moines, IA

Facial pain and pressure is a major factor for diagnosing rhinosinusitis.<sup>1,2</sup> Although impairments in the cervical spine can be related to headaches, the relationship between cervical spine impairments and sinus headaches has not been examined.<sup>3</sup> Reports indicate individuals with sinus headaches have quality of life impairments compared to healthy subjects.<sup>4-6</sup> The purpose of this study was to determine if a difference in upper cervical pain pressure threshold (PPT) exists between those with and without sinus headaches. A secondary purpose was to determine if there is a correlation between quality of life scores and cervical PPT.

Sixty-one subjects participated in this study. Participants with headaches completed the Sinonasal Outcome Test (SNOT-22). All underwent PPT examination using an algometer over C2 articular pillars. Subjects activated a hand-switch which recorded pressure at onset of pain. Analysis included independent t-test for between group differences and Pearson correlation for PPT and SNOT-22.

A significant difference between groups was found for PPT ( $p < 0.05$ ; 95% CI 0.15- 9.24). Mean PPT was  $22.8 \text{ N} \pm 6.9$  and  $27.5 \text{ N} \pm 10.5$  for headache and control groups respectively. Mean SNOT score was  $36.2 \pm 15.3$ . There was no correlation between PPT and SNOT-22 ( $r = 0.0044$ ).

Patients with sinus headaches perceived pain at lower thresholds indicating potential cervical involvement. Clinicians should examine the cervical spine in patients with sinus headaches for possible impairments, as there may be significant clinical implications. Further investigation is needed to determine if people with sinus headaches and neck impairment respond to cervical interventions.

## Biomechanical Indicators Related to Pronation: A Bottom-up Perspective of Running Gait Analysis

---

**Donald T. McDonald, DPM'20<sup>1</sup>**, Carolyn F. Weber, DPT'19<sup>2</sup>, Shane McClinton, PT, PhD, OCS, FAAOMPT<sup>2</sup>

<sup>1</sup> Doctor of Podiatric Medicine and Surgery Program, Des Moines University, Des Moines, IA

<sup>2</sup> Doctor of Physical Therapy Program, Des Moines University, Des Moines, IA

Foot pronation is a natural shock-absorption mechanism during stance phase of running gait offsetting ground reaction forces. Additional force dispersion occurs in the proximal lower extremity and trunk but their relationship to pronation remains unclear. Both limbs of 27 participants (12 male, 15 female) were included in this study for a total of 54 limbs. 2D video gait analysis was used to measure hip drop, medial foot crossover, and trunk rotation. RunScribe sensors attached to each shoe measured pronation excursion and shock (composite of braking and impact forces). The 54 participant limbs were separated into tertiles based on pronation excursion values. The highest and lowest tertiles were used to compare limbs with high ( $>12.3^\circ$ ,  $N=18$ ) and low ( $<9.1^\circ$ ,  $N=19$ ) pronation excursion using ANCOVA adjusted for running speed. Trunk rotation total range of motion (TROM) was increased by  $5.3^\circ$  (95% CI 0.6-10,  $P=0.03$ ) in limbs with high pronation. Although not statistically significant, high pronating limbs demonstrated less contralateral hip drop ( $1.3^\circ$ , 95% CI -0.16-4,  $P=0.07$ ) and increased ipsilateral foot crossover ( $0.5^\circ$ , 95% CI -0.02-1,  $P=0.06$ ). Interestingly, ipsilateral and contralateral shock were not correlated with pronation excursion ( $P>0.58$ ). Evidence from this preliminary analysis indicate that variations in extremes of pronation excursion may be related to proximal kinematic changes such as trunk TROM and ipsilateral foot crossover, offsetting total forces on the body during stance phase of running. Additional research is needed to validate 2D measures and establish confidence in the relationship of these factors in individuals with high and low pronation excursion.

## Predictors of Response to Treatment for Plantar Heel Pain

---

Donald T. McDonald, DPM'20<sup>1</sup> and Shane McClinton, PT, PhD, OCS, FAAOMPT<sup>2</sup>

<sup>1</sup> College of Podiatric Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> Doctor of Physical Therapy Program, Des Moines University, Des Moines, IA

Plantar Heel Pain (PHP) is a common foot and ankle condition resulting in disability and pain. Patients often suffer recurrent symptoms despite treatment. BMI, prolonged weight-bearing, and limited dorsiflexion are known risk factors for PHP but there is limited information on factors predicting treatment response. The objective of this study was to assess factors that predict success with conservative treatment of PHP. Participants included 88 individuals (75% female) from both treatment arms of a randomized clinical trial that compared usual podiatric care with and without physical therapy treatment. Multiple logistic regression was used to assess predictors of success 6 months after initiating treatment for PHP. Treatment success was defined as improvement in pain and function scales greater than the minimal clinically important difference. Predictors included daily weight-bearing hours, symptom duration, BMI, household income, patient expectations of improvement, and fear-avoidance beliefs. Results showed no statistically significant predictors of treatment success, but daily weight-bearing hours was the strongest predictor (OR = 0.9, 95% CI = 0.8, 1.01,  $p = .07$ ). Interestingly, successful treatment was associated with longer weight-bearing hours ( $\bar{x} = 7.3 \pm 3.9$  vs.  $5.7 \pm 3.2$ ). This study was an exploratory analysis of a clinical trial and results should be interpreted with caution. Longer daily weight-bearing hours may be a factor related to successful treatment outcome explained by an established association between PHP and foot and ankle weakness. Additional research is needed to increase confidence in factors related to treatment response.

◆ 56 ◆

## A Top-Down Perspective on Running: Relationships Between Trunk and Arm Kinematics and Established Risk Factors for Lower Extremity Injuries

---

Carolyn F. Weber, DPT'19<sup>1</sup>, Donald T. McDonald, DPM'20<sup>2</sup>, Shane McClinton, PT, PhD, OCS, FAAOMPT<sup>1</sup>

<sup>1</sup> Doctor of Physical Therapy Program, Des Moines University, Des Moines, IA

<sup>2</sup> College of Podiatric Medicine and Surgery, Des Moines University, Des Moines, IA

Running injuries affect 56% of recreational runners annually, stemming partly from biomechanical factors that channel forces into specific joints or tissues. Recent research suggests that arm and trunk kinematics assist in neutralizing forces that move proximally from the foot after initial contact, but their relationships with established risk factors for lower extremity (LE) injuries remain unclear. These relationships were investigated in a preliminary study of 27 recreational runners (15 females, 12 males) using 2D gait analysis in the frontal (hip drop, mediolateral foot placement, shoulder abduction, trunk sidebending), sagittal (shoulder extension) and transverse planes (shoulder girdle rotation (SGR)). Pronation excursion, impact (Gs), braking (Gs), contact time, and cadence were measured for each runner's LE's with RunScribe sensors on each shoe. Average braking, impact and contact times were relatively symmetrical with left:right ratios ranging from 0.994 to 1.03. In contrast, average left SGR was 1.3 times (SD=0.58) greater than right SGR and inversely correlated with average right pronation ( $R=0.52$ ,  $P=0.006$ ), which was 1.29 times (SD=0.50) greater than average left pronation. Like SGR, left trunk sidebending was greater than right for 22 runners, with 5 runners maintaining left trunk sidebending in both midstance phases. Left trunk side bending was positively correlated with frontal plane kinematics (left knee varus:  $R=0.50$ ,  $P=0.009$ ; left hip drop:  $R=0.52$ ,  $P=0.006$ ; mediolateral left foot placement:  $R=0.40$ ,  $P=0.044$ ). These findings warrant future research investigating the relationships between trunk, arm and LE kinematics in the context of specific LE injuries and how manipulating trunk and arm movement affects LE kinematics.

## The Figure-of-8 Walk Test: A Clinical Measure of Motor Skill in Walking for Persons with Parkinsons Disease

---

**Taylor Woods, DPT'20<sup>1</sup>**, Amanda Brandt<sup>1</sup>, Alex Krajek<sup>1</sup>, Ann Smiley-Oyen<sup>2</sup>, Kristin A. Lowry, PhD<sup>1</sup>, Jessie VanSwearingen<sup>3</sup>

<sup>1</sup> Department of Physical Therapy, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Kinesiology, Iowa State University, Ames, IA

<sup>3</sup> Department of Physical Therapy, University of Pittsburgh, Pittsburgh, PA

**Background:** The Figure-of-8 Walk Test (F8W), a measure of curved-path walking ability, has been validated as a measure of walking skill in older adults with mobility disability and persons with stroke; however, the utility of this test in assessing walking skill in persons with Parkinson's (PWP) has not been investigated. We examined validity of the F8W for use with PWP through associations with measures of usual gait, cognition and physical function, and determined the ability of the F8W to discriminate differences in the motor control of walking between PWP and healthy older adults (OA).

**Materials/Methods:** Persons with Parkinson's (n=60) and older adults (n=34) participated in studies where the following measures were collected: the time and number of steps to complete the F8W, usual gait speed, stride time variability during usual straight-path walking, the Montreal Cognitive Assessment (MoCA), and the Late Life Function & Disability Instrument (LLFDI).

**Results:** Compared to OA, PWP were slower and took more steps to complete the F8W. In general, among PWP, F8W performance was associated with established measures of gait, cognition, and physical function. Additionally, the time to complete the F8W demonstrated greater sensitivity and specificity compared to usual gait speed in distinguishing differences in the motor control of walking.

**Conclusions:** The F8W test demonstrates validity for use with PWP. Data suggest that the F8W test uncovers walking difficulties not identified by usual gait speed. Further work is needed to examine the responsiveness of the measures.

## Cues Matter: The Effect of Cueing on Gait Automaticity in Young Adults

---

**Noel Murray, DPT'18**, Alex Krajek, Taylor Woods, DPT'20, Corrin Russell, DPT'19, Kristin A. Lowry, PhD

Des Moines University, Des Moines, IA

**Objective:** The purpose of the study was to examine age- and disease-related effects of cueing on gait control by comparing young adults, healthy older adults, and persons with Parkinsons disease. For this project, we examined a subset of young adult data and hypothesized that verbal cues would worsen neuromotor control by disrupting gait automaticity.

**Methods:** 30 young adults participated. Using an instrumented walkway (Protokinetics, Inc), participants completed 4 trials of each: 1) usual walking (US), 2) to 'think big', plus verbal cues to increase step length (VC), 3) walking with metronome set at preferred cadence (MT), and 4) both verbal cues and a metronome. The following variables were determined from walkway data: speed, step length, cadence, standard deviations (SD) of stride width, step time, and step length, and the walk ratio (step length/cadence). Repeated Measures ANOVAS were used to examine condition effects with appropriate pairwise comparisons.

**Results:** Significant condition effects were noted for all variables ( $p < .005$ ) except stride width SD ( $p = 0.077$ ). Compared to US, VC and VCM resulted in increased speed ( $1.4 \pm .14$ ,  $1.67 \pm .21$ ,  $1.87 \pm .21$ , respectively), increased step length ( $.74 \pm .05$ ,  $.93 \pm .10$ ,  $.96 \pm .08$ ), altered cadence ( $113.88 \pm 7.27$ ,  $108.37 \pm 9.20$ ,  $116.42 \pm 8.33$ ), increased stride width ( $10.9 \pm 2.6$ ,  $12.2 \pm 4.0$ ,  $12.7 \pm 3.7$ ), increased step length SD ( $1.7 \pm .63$ ,  $2.4 \pm .88$ ,  $2.3 \pm .76$ ), and altered walk ratio ( $0.65 \pm 0.06$ ,  $0.86 \pm 0.12$ ,  $0.83 \pm 0.09$ ).

**Conclusion:** Our hypotheses were supported; young adults exhibited increased base of support, loss of consistency of stepping, and poorer global neuromotor control during conditions with verbal cues. These data suggest that when automatic processes are intact, verbal cues are disruptive to gait performance.

## Active and Passive Foot Arch Support Mechanisms Under Various Weight-Bearing Conditions

---

**Alena Kelly, DPM<sup>'20</sup>**, Kiera Bengel, DPM<sup>'20</sup>, Robert Yoho, DPM, David Stapleton, BS, Vassilios Vardaxis, PhD

Des Moines University, Des Moines, IA

The etiology of lower extremity overuse injuries and are vast and inconclusive. While proximal and distal lower extremity paradigms have been proposed, they failed to support cause-effect relationships, and suggested further work to: address methodological limitations; develop more robust methods for foot classification; and provide clearer definitions for the related musculoskeletal injuries. A limitation of the distal paradigm is that it ignores the active structures (intrinsic muscles of the foot) in terms of arch support. It has been suggested that weakness in the intrinsic foot muscles does not provide sufficient dynamic support to the longitudinal arches of the foot, which results in increased strain on the plantar fascia. Literature recommendations support strengthening exercises of the intrinsic foot muscles, however their role in the dynamic function is unclear. The specific aims of this study are: (i) to evaluate the extent to which the size of the plantar fascia and the intrinsic toe flexor muscle size, strength, and change in size are related to mobility characteristics of the foot (rigid/stiff, neutral, flexible) and (ii) assess the relationship between load magnitude, location, and distribution under the foot to the static and dynamic foot mobility/deformation. A cross sectional, case control study design will be used to assess morphological characteristics and strength performance (for the intrinsic toe flexor muscles and plantar fascia) compared across groups of different foot mobility, during static and dynamic weight bearing tasks.

## Identification of the Scapular Plane for Arm Elevation in Non-Symptomatic Adults

---

**Jeff Mann, DO<sup>'20</sup><sup>3</sup>**, Jordan Estes, DO<sup>'20</sup><sup>3</sup>, David Stapleton, BS<sup>2</sup>, Traci Bush, DPT, OTR/L, DHS<sup>1</sup>, Vassilios Vardaxis, PhD<sup>1,2</sup>

<sup>1</sup> Department of Physical Therapy, Des Moines University, Des Moines, IA

<sup>2</sup> Human Performance Laboratory, Des Moines University, Des Moines, IA

<sup>3</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

The scapular plane is a surface perpendicular to the floor coincident to the body of the ipsilateral scapula. Arm elevations on the scapular plane “scaption”, are used predominantly by clinicians during examination and exercise prescription for patients with shoulder pathology. However, the literature lacks specificity in the definition of the scapular plane, with respect to its exact location and variability amongst individuals. Studies using the scaption task perform arm elevations on planes anywhere between 20 and 45 degrees to the frontal plane. The purpose of this study is to determine the location of the scapular plane using muscle activation measurements (Electromyography-EMG) of the anterior and posterior deltoid muscles.

Twenty (20) healthy male participants completed 4 trials of an arm elevation task (elbow fully extended) to 120 degrees, while seated, on each of 13 systematically varying planes of arm elevation, between 0° and 90° to the frontal plane. 3D motion (31 reflective markers @ 120Hz) and EMG (11 muscles @ 1200Hz) data were captured using the Human Performance Laboratory's 10-camera data acquisition system. The Direct Co-Contraction Ratio (DCCR) algorithm was used to evaluate the antagonistic effect of the anterior and posterior deltoids.

Preliminary results on 8 participants place the scapular plane at 26.1° (SE 5.1°) anterior to the frontal plane, with a 95% confidence level at 12.1° around the mean (14° to 38.2°). The lowest and highest values observed (for subject specific scapular plane) were: 4.7° and 48.1°, respectively.

## Effect of Load and Motion Direction on Shoulder Scapulohumeral Rhythm (SHR)

---

**Matthew Gibbs, DO'20<sup>3</sup>**, J. Thomas Lowe, DO'20<sup>3</sup>, Jacob Ahles, DO'20, MSA'20<sup>3</sup>, Jase Schossow, DO'20, MSA'20<sup>3</sup>, David Stapleton, BS<sup>2</sup>, Traci Bush, DPT, OTR/L, DHS<sup>1</sup>, Vassilios Vardaxis, PhD<sup>1,2</sup>

<sup>1</sup> Department of Physical Therapy, Des Moines University, Des Moines, IA

<sup>2</sup> Human Performance Laboratory, Des Moines University, Des Moines, IA

<sup>3</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

Shoulder injury, including impingement of the subacromial space, often manifests with scapular dyskinesis. While upward migration of the humeral head, failure to elevate the acromion during arm movements, and loading the scapula have been shown as causes, a link between load handled and altered scapular motion remains elusive. This project aims to demonstrate scapular dyskinesis due to external conditions, e.g. handheld weights lifted at different locations in the workspace.

Twenty-five (25) male subjects, without musculoskeletal problems, will be recruited for the study. Participants will undergo ultrasonography with an ultrasound probe marked with a 4-reflective marker cluster to capture 6 separate cross section video scans of the anterior aspect (3) and posterior aspect (3) of the glenohumeral joint. Ultrasound data will be collected using a SonoScape Linear Array Transducer (L741), synchronized to the motion capture via Cortex Motion Analysis software. Participants will then elevate the right arm to ~120 degrees of Range of Motion along 3 unique planes (0, 30, and 90 degrees). Five trials will be performed for each plane under each of the following five conditions: (1) no load with palm towards the midline, (2) no load with the palm away from the midline, (3) - (5) with the palm towards the midline with loads of 1Lbs, 3Lbs and 5Lbs attached to the hand/wrist respectively. All trials will be performed from a seated position. Motion will be captured via Cortex. Euler angles will be used to compute 3D ST motion, per International Society of Biomechanics recommendations.

## An Anatomical Study of Three-Dimensional Frontal Plane Rotation in Hallux Abducto Valgus Deformity with Clinical Applications to Surgery

---

**Stefany Beraldo, DPM'20<sup>1</sup>**, **John Walsh, DO'20<sup>2</sup>**, Paul Dayton, DPM, MS, FACFAS<sup>1</sup>

<sup>1</sup> College of Podiatric Medicine and Surgery, Des Moines University, Des Moines, IA

<sup>2</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

**Background:** The paradigm of Hallux Abducto Valgus (HAV) deformity correction fails to resolve the true etiology. Hundreds of procedures exist using a two-dimensional (2D) deformity correction. Subsequently, corrective techniques are inadequate in restoring anatomy. Frontal plane rotation of the metatarsal remains unaddressed leading to complications and high long-term recurrence.

**Purpose:** The purpose of this study is to understand and quantify three-dimensional (3D) deformity for clinical assessment and surgical management.

**Study Design:** An anatomic and imaging study of HAV deformity in the first ray.

**Methods:** Ten cadaveric specimens were dissected to evaluate osseous landmarks, relevant surrounding soft-tissue structures, and HAV deformity of the first ray. Five cadaveric specimens with no history of surgery or deformity and five specimens conventionally diagnosed with HAV deformity by senior author (PD). The orientation, location, and relationship of key HAV landmarks were determined by anterior-posterior radiograph and PedCAT weight-bearing Computer Tomography (CT). Images obtained were used for standard HAV measurements: intermetatarsal angle (IMA), hallux abductus angle (HAA), Tibial Sesamoid Position (TSP), cuneiform obliquity angle (COA), proximal metatarsal obliquity angle (PMOA), and frontal plane rotation (FPR).

**Clinical Relevance:** An analysis of transverse, sagittal and frontal plane deformity changes to the first ray on 2D and 3D imaging for correlation and establishment of standard reference points for consistent clinical interpretation and surgical management.

## The Influence of Sexual Dimorphism on Outcomes After Primary Hip Arthroscopic Surgery in the Presence of Borderline Dysplasia: A Match-Controlled Study with a Minimum 2-Year Follow-Up

---

John Walsh, MA, DO<sup>20</sup><sup>1</sup>, David Hartigan, MD<sup>2</sup>, Benjamin Domb, MD<sup>3</sup>

<sup>1</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> Mayo Clinic, Phoenix, AZ

<sup>3</sup> American Hip Institute, Westmont, IL

**Introduction:** There is an increasing awareness of sex differences in clinical presentation and management of hip pathology. In Borderline dysplasia (BD), pelvic structure and joint laxity may be particularly relevant. No study has evaluated the impact of the morphologic differences on arthroscopic management outcomes.

**Methods:** Data were prospectively collected on all patients undergoing surgery. Eligible patients had undergone primary hip arthroscopic surgery for symptomatic labral tears in the presence of BD. Patients were excluded for Tonnis grade >1, worker's compensation claims, previous hip conditions, and labral resection. Male (M) and female (F) patients were matched in a 1-to-1 ratio according to age, BMI and by lateral center edge angle. Three patient-reported outcome scores and the visual analog scale for pain were recorded.

**Results:** The M cohort had significantly increased mean alpha angle, crossover sign, acetabular Outerbridge 3, ALAD 3, and acetabuloplasty. The F cohort had significantly increased internal and external rotation, flexion and abduction range of motion preoperatively. F had increased Domb LT tear 3 classification. Both groups demonstrated significant improvements in mean PRO scores, but F scores were consistently lower in pre-operative and latest outcome scores. Clinical significance thresholds, minimal clinical important difference and patient acceptable symptomatic state, highlight important differences between M and F outcomes.

**Conclusion:** In BD, sexually dimorphic characteristics influence outcomes of hip arthroscopic surgery with labral preservation and capsular plication. F may require stricter parameters or enhanced rehabilitation to meet therapeutic benefits.

## Progression of Radiographic Healing Following First Ray Arthrodesis in the Foot Using a Biplanar Plating Technique Without Compression

---

Rachel Ellen Egdorf, DPM<sup>19</sup>, Andrea Cifaldi, DPM<sup>18</sup>, Jake Eisenschink, DPM<sup>19</sup>, Paul Dayton, DPM, MS, FACFAS

College of Podiatric Medicine and Surgery, Des Moines University, Des Moines, IA

The role of fixation to optimize healing following arthrodesis of the first ray has been highlighted in recent years as our understanding of the ideal mechanical environment for bone healing has evolved. A biplanar plating construct, utilizing two low profile locking plates at 90 degrees to each other without interfragmentary compression balances multiplanar stability with the desired cyclic mechanical loading, allowing for adequate callus formation and increased healing strength. This fixation construct was evaluated in a consecutive patient cohort of 249 patients undergoing first tarsometatarsal joint (TMTJ) arthrodesis or first metatarsophalangeal joint (MTPJ) arthrodesis. After application of the inclusion and exclusion criteria, 202 feet have been included in the present study. Two-view radiographs were used to assess the progression of healing at the following post-operative time frames: 4-9 weeks, 10-12 weeks, >12 weeks and final follow-up. Healing was defined as an increase in radiodensity and trabecular pattern at the arthrodesis site, absence of hardware loosening or failure and maintenance of arthrodesis position. Within the cohort, 117 feet underwent first TMTJ arthrodesis and 85 underwent first MTPJ arthrodesis. The overall union rate for both groups exceeded 95% at the final follow-up and an increased progression towards radiographic healing was present at each interval following initial post-operative radiographs. The results of this patient cohort demonstrate the ability of a biplanar plating construct without interfragmentary compression to consistently produce high fusion rates following first TMTJ or first MTPJ arthrodesis.

## Changes in Osseous Forefoot Angular Relationships, Force and Pressure Patterns in Association with Foot Flexibility and the Jones Fracture

---

Robert Yoho, DPM, MS, Vassilios Vardaxis, PhD, David Stapleton, BS, Amy Ross, DPM'20, **Jacob Harder, DPM'20**

College of Podiatric Medicine and Surgery, Des Moines University, Des Moines, IA

**Background:** The Jones fracture is an injury to the fifth metatarsal associated with certain sports. Previous research has identified foot structure as a risk factor. There are no studies that assess the relationship between foot type, load changes and movement with this injury. This study will evaluate changes in foot structure, force magnitude, and plantar pressures in subjects with a rigid versus a flexible foot type.

**Method:** Subjects will be screened to determine foot type. Only rectus feet classified as rigid, neutral or flexible will be included in the study. 20 healthy subjects between the ages of 22-40 will be enrolled for each rectus/flexibility group. Each subject will have six radiographs taken at different loads. Angular relationships will be measured. Each subject will be asked to walk in a straight line on the force plate and pressure mat. This will be repeated making a cross-cut at a 45° angle. Data will be collected on changes in pressure and force.

**Literature Review:** Current literature suggests metatarsus adductus, hindfoot varus and foot rigidity increase the risk of foot fractures. The unique anatomy of the proximal fifth metatarsal, combined with the forces and pressures occurring with a cross-cut maneuver may increase the chance of the Jones fracture. We anticipate increased force and pressure localized to the lateral column of the foot near the base of the 5th metatarsal in subjects with more rigid foot types and metatarsus adductus.

**Summary:** This study was approved by the DMU IRB, a grant has been submitted for funding, and we anticipate collecting data in 2018.

## Comparison of Metabolic Bone Markers in Diabetics with Peripheral Neuropathy to Non-Diabetic Subjects

---

Robert Yoho, DPM, MS, FACFAS, **Brittany Nino, DPM'19**, Edee Wildman, DPM'20

College of Podiatric Medicine and Surgery, Des Moines University, Des Moines, IA

**Purpose:** The purpose of this case-control study is to compare the metabolic bone status of 20 diabetic subjects with existing peripheral neuropathy to 20 non-diabetic subjects. Various metabolic bone indicators will be assessed to determine the risk for bone washout, creating the potential for the development of Charcot neuropathy, a limb threatening condition frequently associated with diabetic neuropathic patients. Metabolic bone indicators in non-Charcot neuropathic diabetic patients has never been evaluated.

**Literature Review:** Vitamin D is crucial to bone homeostasis. A depletion of vitamin D levels leads to decreased calcium which can result in secondary hyperparathyroidism. A consequence being bone washout and increased risk of fracture. Diabetic patients with peripheral neuropathy are known to be at risk for Charcot neuroarthropathy due to neurovascular and neurotraumatic abnormalities.

**Method:** Participants will be 30-70 years old. Each subject will have blood drawn to measure serum vitamin D, calcium, parathyroid hormone, and hemoglobin a1c. Percent body fat and bone density will be assessed with a DXA body scan. Statistical analysis will include a two-sample T-test, to test for difference in the means of the independent samples or unpaired samples. We will consider an analysis of variance to compare data between groups and within groups.

**Summary:** We anticipate individuals with diabetes have decreased vitamin D levels and elevated parathyroid hormone levels, predisposing to them to debilitating conditions like Charcot neuroarthropathy. Hence the need to closely manage the overall health of diabetic patients.

This study was approved by the DMU IRB, received funding from the DMU R&G Committee, and we are currently collecting data.

## Shoulder Muscle Activation Synergies During Arm Elevation in Different Body Positions

---

David Stapleton, BS<sup>1</sup>, Samuel DeBoer, DPT<sup>1</sup>8<sup>2</sup>, Traci Bush, DPT, OTR/L, DHS<sup>2</sup>, Vassilios Vardaxis, PhD<sup>1,2</sup>

<sup>1</sup> Human Performance Laboratory, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Physical Therapy, Des Moines University, Des Moines, IA

In non-pathological shoulder complex function, the humerus and scapula move in a predictable pattern identified as “scapulohumeral rhythm”, viewed on the scapular plane as the relative motion between the scapulothoracic and glenohumeral joints. This rhythm can be modulated by the activation pattern of the muscles that move and stabilize the shoulder complex, as well as the load and rotation of the arm. The activation of these muscles is shown to increase with increased humeral elevation and seem to operate in synergistic activation patterns which are also affected by pathology and level of impairment. We hypothesize that synergistic activation will also be affected by body position (gravitational load modification) and the plane of arm elevation.

Eighteen non-pathological right-handed males aged 24.0±1.7 years participated. Each was asked to elevate their arm from a resting position to 120° in the flexion and abduction planes in seated, prone, sidelying, and supine body positions. Motion capture was used to track arm elevation and surface electromyography (EMG) was used to record muscle activation. EMG data was averaged across three elevation segments (0-30°, 30-60°, and 60-90°). Scaled co-activations were calculated for each of the three deltoid parts (anterior, middle, posterior) with the upper trapezius muscle. Co-activations were evaluated across elevation segment, elevation plane, and body position.

While not all interactions produced significant differences, the synergistic patterns observed add to our understanding of the dependency of various muscle pairings on position, task, and arm elevation; and should be accounted for in the development of clinical/rehabilitation protocols.

## Effect of Body Position on the Scapulothoracic Motion During Dynamic Dominant Arm Planar Elevation

---

Vassilios Vardaxis, PhD<sup>1,2</sup>, Matthew Glazier, DO<sup>1</sup>9<sup>3</sup>, David Stapleton, BS<sup>2</sup>, Traci Bush, DPT, OTR/L, DHS<sup>1</sup>

<sup>1</sup> Department of Physical Therapy, Des Moines University, Des Moines, IA

<sup>2</sup> Human Performance Laboratory, Des Moines University, Des Moines, IA

<sup>3</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

Humeral elevation as related to the thorax is a complex motion that requires scapular stability and mobility for normal shoulder function. The scapulothoracic (ST) motion facilitates glenoid fossa orientation for proper glenohumeral joint function. Alterations in ST kinematics have been shown to be related to shoulder pathology/dysfunction. The purpose of this study is to compare the dynamic 3D ST kinematics between various common clinical evaluation positions of healthy controls while performing the task of arm elevation in the frontal and sagittal planes.

Eighteen (18) healthy male participants without any musculoskeletal problems volunteered for the study. Participants completed 5 trials of the task (arm elevation in the sagittal and frontal planes to ~110 degrees) in 4 different body positions: seated, sidelying, prone and supine. A motion analysis system with 10-cameras running at 120 Hz was used to capture 3D data of reflective markers attached to the upper-limb, and torso. Euler angles were used to compute 3D ST motion, per ISB recommendations.

Significant interaction effects were found for the ST motion (arm elevation angle X body position) in the frontal and sagittal planes (2-way RM-ANOVA; F=5.84, p=0.001 & F=4.96, p=0.002, respectively). The body position predominantly affected the internal-external and downward-upward rotation of the scapula during the arm elevation task. Its effect was found to be depended on the specific plane of arm elevation.

Body position and plane of elevation must be considered when selecting therapeutic exercises, focusing on the restoration of optimal shoulder complex movement including correction of scapular dyskinesis.

## Glenohumeral Joint Motion with Arm Elevation in the Frontal & Sagittal Plane at Common Clinical Evaluation Body Positions

---

**Vassilios Vardaxis, PhD<sup>1,2</sup>**, Michael Maiden<sup>3</sup>, David Stapleton, BS<sup>2</sup>, Traci Bush, DPT, OTR/L, DHS<sup>1</sup>

<sup>1</sup> Department of Physical Therapy, Des Moines University, Des Moines, IA

<sup>2</sup> Human Performance Laboratory, Des Moines University, Des Moines, IA

<sup>3</sup> College of Osteopathic Medicine, Des Moines University, Des Moines, IA

Arm elevation tasks are routinely used for clinical evaluation purposes and upper-extremity rehabilitation programs for glenohumeral (GH) dysfunction. Existing protocols often incorporate placement of the patient in various body orientation positions to assess function and alter the intensity of exercise/rehabilitation. The purpose of this study is to understand the glenohumeral joint motion during active arm elevation tasks performed at various common clinical evaluation positions.

Eighteen (18) healthy male participants volunteered for the study. Participants completed 5 trials of the task (arm elevation in the sagittal and frontal planes to ~110°) in 4 different body positions: seated, sidelying, prone and supine. Euler angles were used to compute 3D glenohumeral motion, per ISB recommendations.

There were no significant differences in arm elevation level between body positions or elevation planes (Elevation ROM: 100.1±4.2°). When pooled across body positions and elevation planes 68.1±4.1° was contributed from the GH joint vs. 33.4±7.2° from the ST. Across positions there was a significantly higher contribution from the GH joint for the frontal vs. sagittal plane. The difference was smaller for the seated and supine (2.3° and 2.8°, respectively @ p=0.03) and larger for the sidelying and prone positions (12.6° and 8.9°, respectively @ p=0.001).

The glenohumeral motion as reflected by 3D kinematics varied with the plane of arm elevation, palm orientation, and body position. These findings expand our understanding of the healthy GH joint motion during active arm elevation and can be used to aid in the assessment of glenohumeral dysfunction and the planning of rehabilitation protocols.

## Comparative EMG Analysis of Shoulder Girdle Muscles During Cardinal Plane Arm Elevation at Different Body Positions

---

**Traci Bush, DPT, OTR/L, DHS<sup>1</sup>**, Asher Bogdanove, DPT<sup>1</sup>19<sup>1</sup>, Clare Goerd, DPT<sup>1</sup>19<sup>1</sup>, David Stapleton, BS<sup>2</sup>, Vassilios Vardaxis, PhD<sup>1,2</sup>

<sup>1</sup> Doctor of Physical Therapy Program, Des Moines University, Des Moines, IA

<sup>2</sup> Human Performance Lab, Des Moines University, Des Moines, IA

Shoulder muscle activation disparity can result in imbalances and impaired biomechanics, exacerbating pathology and delaying recovery. Plane of movement and body position can alter shoulder muscle activation and affect magnitude and direction of glenohumeral joint force. This study assessed the effect of elevation plane of motion and body position on shoulder muscle activation. We hypothesized elevation demand on muscles will be affected by plane of motion and body position in terms of peak activation and coincidental angle of elevation.

Eighteen right-handed, healthy males elevated their right arm in the frontal and sagittal planes in seated, sidelying, prone, and supine positions. Arm motion was monitored using 3D motion capture. Muscle demand was assessed using peak activation (%manual muscle testing-%MMT) and the coincidental angle (shoulder elevation angle at peak %MMT). Surface EMG electrodes were placed on 8 shoulder girdle muscles. The dependent variables were peak EMG activation and coincidental elevation angle. A 2-way repeated-measures ANOVA design tested for significant differences.

Significant 2-way interactions were observed in peak EMG activation and coincidental elevation angle for all muscles. Significant plane of motion main effects were observed in EMG activation for the upper trapezius, middle deltoid and posterior deltoid, with higher activation for the frontal plane for all positions. We observed significant position main effects in EMG activation for all muscles.

The findings demonstrate the interaction of body position and plane of motion significantly impact muscle activation, and therefore should be considered in rehabilitation to identify optimal exercises establishing appropriate intensity to meet recovery goals.



## Methylation Levels at Growth Differentiation Factor-15 Related CpG Sites are not Related to Death Risk from Cardiovascular Disease: National Heart, Lung, and Blood Institute Twin Study

Pallavi Mukherji, DO'20<sup>1</sup>, Ming Leung, MS<sup>1</sup>, Ruth Krasnow<sup>2</sup>, Terry Reed<sup>3</sup>, Wael El-Rifai<sup>4</sup>, Jun Dai, PhD, MD, MSc<sup>1</sup>

<sup>1</sup> Department of Public Health, College of Health Sciences, Des Moines University, Des Moines, IA

<sup>2</sup> Center for Health Sciences, SRI International, Menlo Park, CA

<sup>3</sup> Department of Medical and Molecular Genetics, Indiana University School of Medicine, Indianapolis, IN

<sup>4</sup> Department of Surgery, Vanderbilt Medical Center and Vanderbilt-Ingram Cancer Center, Nashville, TN

**Background:** A prior study reported potential associations between methylation at four CpG sites related to growth differentiation factor-15 (GDF-15) and myocardial infarction. It is unknown whether methylation at these sites is associated with the risk of death from cardiovascular disease (CVD). We aimed to investigate such associations independent of genes and shared environmental factors.

**Method:** We included 19 male monozygotic twin pairs middle-aged in 1969-1973 and discordant for CVD death through December 31, 2014 from the NHLBI Twin Study. Buffy coat DNA samples were collected in 1986-1987. Genome-wide DNA methylation levels were quantified using the Infinium HumanMethylation450K BeadChip. Conditional logistic models were used to estimate hazard ratio (HR). Baseline CVD risk factors were adjusted.

**Results:** The crude HRs were not statistically significant for 4 CpG sites. After adjustment for body mass index, years of education, and Framingham risk scores, HR was 0.03 (95%CI: 0.00, 45281.06), 700.96 (95%CI: 0.00, 2.32X10<sup>8</sup>), 0.00 (95%CI: 0.00, 7.35), and 0.81 (95% CI: 0.00, 1.44X10<sup>6</sup>) for cg13033585, cg16936953, cg17150809, and cg18608055, respectively. Adjustment for cell subtypes dramatically changed the HR and/or widened corresponding 95% CIs, suggesting overadjustment bias.

**Conclusion:** Methylation at GDF-15 and MI related CpG sites may not be associated with death risk from CVD independent of genes and shared environment.

## Regulation of Cardiac Adrenergic Response by the G Protein-Coupled Estrogen Receptor

Victoria Whitcomb, MBS'21, Vahe Matnishian, DPM'20, MBS'16, Eric Wauson, PhD, Sarah Clayton, PhD, Jennifer Giles, MA, Quang-Kim Tran, PhD, MD

Department of Physiology and Pharmacology, College of Osteopathic Medicine, Des Moines University

Estrogen possesses many cardiovascular protective effects. However, hormone replacement in postmenopausal women has not produced the desired effects. We have begun testing the idea that specific targeting of estrogen receptors is required to achieve the desired outcomes. Here, we tested the hypothesis that the G protein-coupled estrogen receptor 1 (GPER) moderates myocardial adrenergic functions via interactions with the  $\beta_1$  adrenergic receptor ( $\beta_1$ AR).

Cardiomyocytes freshly isolated from C57BL/6J mice display robust  $Ca^{2+}$  signals in response to  $\beta_1$ AR agonist isoproterenol. Pharmacological inhibition of GPER significantly increases the amplitude and frequency of isoproterenol-induced  $Ca^{2+}$  oscillations. In H9C2 cardiomyocytes, isoproterenol also stimulates  $Ca^{2+}$  signals that are inhibited by  $\beta_1$ AR antagonist metoprolol and potentiated by GPER antagonism. Consistently, preliminary data in ovariectomized rats shows that isoproterenol substantially increases aortic pressures, and acute administration of a specific GPER agonist dramatically suppresses isoproterenol's effects. We recently showed that GPER interacts at its four submembrane domains with the ubiquitous  $Ca^{2+}$ -binding protein calmodulin, associations that are required for GPER-mediated signaling. Interestingly,  $\beta_1$ AR coimmunoprecipitates with GPER in H9C2 cardiomyocytes under basal conditions; this association is dynamically reduced by agonism of either receptor and promoted by antagonism of calmodulin. Consistently, confocal microscopy shows 80% colocalization of heterologously expressed GPER and  $\beta_1$ AR.

Our results support dynamic physical and functional interactions between GPER and  $\beta_1$ AR and a role of calmodulin in these associations. Studies are underway to elucidate the details of these interactions, which hopefully will provide grounds for contemplation of specific targeting of estrogen receptors in moderating cardiac functions.

## Climate Change and Feet: Diabetic Foot Ulcers During Heat Waves

---

Rachel Egdorf, DPM<sup>1,2</sup>, Paul Schramm<sup>2</sup>, Kathryn Conlon<sup>2</sup>, Chelsea Austin<sup>2</sup>, George Lubert<sup>2</sup>

<sup>1</sup> Podiatric Medical Student, Des Moines University, Des Moines, IA,

<sup>2</sup> Centers of Disease Control and Prevention, Climate and Health Division, Chamblee, GA

The findings and conclusions in this document are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention or Des Moines University.

Heat waves are periods, lasting at least 2 days of abnormally and uncomfortably hot weather. For five decades, the incidence of heat waves has increased across the United States. Heat waves have a well-known effect on human health including heat stress, gastrointestinal complications, cardiovascular problems, and even death. Past studies have established escalations in emergency department visits during heat wave days compared to non-heat wave days. Between 2006 and 2010, heat waves accounted for 31% of all weather related deaths, with daily mortality rates increasing by an average of 3.7%. Elderly who have preexisting conditions are at an increased risk compared to the general population for mortality during heat waves. With annual temperatures rising and the incidence of heat waves rising, heat related illnesses are also likely to rise.

Currently, no research is available that examines the possible relationship between heat waves and diabetic foot ulcers. The strong correlations between diabetes and Emergency Room visits during heat waves, along with the relationship between diabetes and foot ulcers, signifies the possibility for a correlation between heat waves and diabetic ulcers. The increasing prevalence of diabetes and rising temperatures globally would make this relationship, a serious health concern globally. An investigation into this connection between diabetic foot ulcers and heat waves has the potential to save not only health care cost, but also limbs, quality of life status, and even the lives of a large patient population.

◆ 4:15 pm ◆

## Inhibition of Bone Morphogenic Protein 2-Inducible Kinase (BMP2K) is Protective to Cardiomyocytes Exposed to Simulated Ischemia (sl) Injury

---

Bryan J. Butel, DO<sup>201</sup>, Samuel I. Engman<sup>2</sup>, Lee M. Graves<sup>3</sup>, Eric M. Wauson, PhD<sup>2</sup>

<sup>1</sup> College of Medicine, Des Moines University, Des Moines, IA

<sup>2</sup> Department of Physiology and Pharmacology, Des Moines University, Des Moines, IA

<sup>3</sup> University of North Carolina at Chapel Hill, Chapel Hill, NC

A small percentage of the 518 kinases in the human genome are known to play important roles in the pathophysiology of ischemia injury in cardiomyocytes. However, there are many understudied kinases that may impact the damage to cardiomyocytes caused by ischemia. Thus, there are likely unmet therapeutic opportunities in targeting kinases to reduce death caused by myocardial infarction. We utilized an unbiased mass spectrometry affinity chromatography method to investigate how simulated ischemia (sl) affected the activity of many kinases in a cardiomyocyte cell line. Our data suggested that the activity of bone morphogenic protein 2-inducible kinase (BMP2K) was elevated in cardiomyocytes exposed to sl. No physiological substrates of BMP2K have been identified, and its function has been minimally studied. We determined that both a reduction of BMP2K expression using siRNA, and the treatment of cells with the BMP2K inhibitor LP-935509 reduced sl-induced apoptosis in cardiomyocytes. To identify potential BMP2K substrates and to investigate the molecular mechanism by which inhibiting BMP2K protects cardiomyocytes from sl injury, we performed a quantitative phosphoproteomic screen on proteins from cardiomyocytes exposed to sl that were treated or not treated with LP-935509. We identified numerous proteins from cells exposed to sl that were not treated with LP-935509 that showed increased phosphorylation. A subset of these proteins from cells exposed to sl that were treated with LP-935509 showed decreased phosphorylation. Future studies will be directed at determining if these proteins are direct substrates of BMP2K and if their phosphorylation affects cardiomyocyte viability in response to sl injury.

**Presenting Author Index**

	<b>Oral/Poster</b>	<b>Page</b>
G = Graduate UG = Undergraduate HS = High School		
Adamian, Shant, DO'19 .....	41, 42 G	37
Al Kadhim, Noori, DO'21 .....	26G	29
Ames, Andrew, DO'20 .....	16 G	25
Bachelor, Brooke, DO'19 .....	41 G	37
Balabanov, Dean, DO'20 .....	14 G	24
Beraldo, Stefany, DPM'20.....	62 G	47
Bitterman, Kathleen, BS.....	19	26
Butel, Bryan, DO'20 .....	4:15 pm	54
Burns, Anna .....	28 G	30
Burton, Laura, DPT'18 .....	52 G	42
Bush, Traci, DPT, OTR/L, DHS .....	70	51
Do, Andre .....	29 UG	31
Egdorf, Rachel, DPM'19 .....	64 G, 4 pm	48, 54
Eisenberg, Amy, DO'20, MHA'22 .....	7 G	21
Estes, Kathryn, DO'20 .....	33 G	33
Febel, Neil .....	18 UG	26
Folkerts, Tyler, DO'20 .....	5 G	20
Ghazaryan, Nelli, DO'21 .....	43 G	38
Gibbs, Matthew, DO'20.....	61 G	47
Hackman, Sophia, DO'19, MPH'21 .....	47 G	40
Halbach, Alexandra, DO'20 .....	45 G	39
Harder, Jacob, DPM'20.....	65 G	49
Harris, Kaitlyn.....	40 HS	36
Harrison, Lindsey, DO'20.....	46 G	39
Henry, Matt, PhD .....	37	35
Hodges, Fiona, DO'20 .....	41 G	37

	<b>Oral/Poster</b>	<b>Page</b>
Jokinen, Anna.....	17 UG	26
Kaster, Kyle, DO'20.....	2 G	18
Kaul, Sakshi, DO'21.....	27 G	30
Keenan, Corey, DO'21.....	25 G	29
Kelly, Alena, DPM'20.....	59 G	46
Kim, John, DO'20.....	36 G	34
Knauf, Victoria, DPM'19.....	20 G	27
Larson, Daniel, DPT'18.....	53 G	43
Le, Sandy.....	39 HS	36
Mages, Michelle.....	35 G	34
Mann, Jeff, DO'20.....	60 G	46
Manning, Alicia, DO'20.....	15 G	25
McDonald, Donald, DPM'20.....	54, 55 G	43, 44
McClinton, Shane, PT, PhD, OCS, FAAOMPT.....	56	44
McNitt, Sean, DO'20.....	11 G	23
Mikkilineni, Satvika, DO'20.....	48 G	40
Mittra, Tricia, DO'19.....	41 G	37
Mironov, Natalie, DO'20.....	23 G	28
Mukherji, Pallavi, DO'20.....	3:30 pm	53
Murray, Noel, DPT'18.....	58 G	45
Nino, Brittany, DPM'19.....	66 G	49
Omanovic, Esad.....	30 UG	31
Oren, Shelley, MS.....	38	35
Patton, John, DO'20.....	2 G	18
Reiche, William, DO'20.....	10 G	22
Roland, Miranda, DO'20.....	9 G	22
Roust, Erika, DO'20.....	4 G	19
Schultz, Alexander, DPM'21.....	12 G	23
Schwalbe, Kathryn, DO'18.....	24 G	29
Severa, Kieran.....	34 UG	33

	<b>Oral/Poster</b>	<b>Page</b>
Siddique, Nikhut, DO'18.....	32 G	32
Stapleton, David, BS.....	67	50
Stewart-Hester, Theodore, DO'20 .....	13 G	24
Sturdevant, Kristina.....	51 UG	42
Swenson, Tami, PhD .....	49, 50	41
Tanveer, Zainab.....	1 UG	18
Tenley, Jonathan, DPM'19, MSA'17 .....	21 G	27
Truong, Tuan .....	22 HS	28
Vardaxis, Vassilios, PhD.....	68, 69	50, 51
Walsh, John, MA, DO'20.....	62, 63 G	47, 48
Weinfeld, Michael, DO'20 .....	3 G	19
Whitcomb, Victoria, MBS'21 .....	3:45 pm	53
Woods, Taylor, DPT'20.....	57 G	45
Yuan, LiLian, PhD.....	6	20
Zhu, Alexander, DO'19 .....	31 G	32
Zobel, Adam, DO'20 .....	8 G	21

