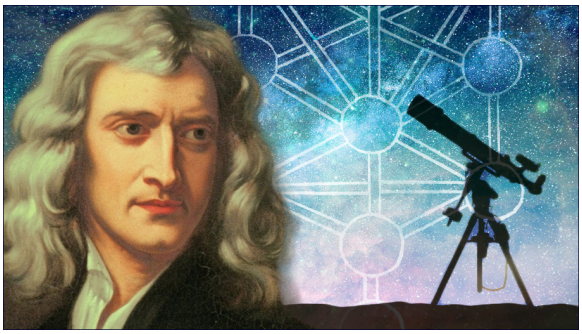
2023

MEDICAL STUDENT RESEARCH DAY

The Burrell College Office of Research and Sponsored Programs



I seem to have been only like a boy playing on the seashore,
and diverting myself in now and then finding a smoother pebble or
a prettier shell than ordinary,
whilst the great ocean of truth lay all undiscovered before me.

Isaac Newton (1642 - 1727)

Contents

President's Welcome Address

It is my privilege to welcome you to the Burrell College of Osteopathic Medicine's 2023 Medical Student Research Day (MSRD)!

Thank you to our participants and visitors for attending the College's premiere student research event. This is the sixth year that the College has hosted this event and I could not be prouder of the students and faculty who have put forth so much effort to make this day possible. Medical Student Research Day is an immensely important day for our students. Not only does MRSD provide our students the opportunity to gain experience that will give them a competitive edge when applying for future residency programs, it also promotes the research and scholarly efforts of the College on a national scale.

I am pleased to see such an impressive turnout of student abstract submissions by our medical students. The research studies presented have significance because of their potential for translation to Osteopathic Medicine. I would like to take a moment to recognize the efforts of our faculty and staff members at the Burrell College Research Laboratories. Without our research mentors and the dedication of the staff of the Research Office, none of this would be possible. The Burrell College research community is a rising force, already making significant contributions to advancing knowledge in basic, clinical, and applied biomedical research.

Please join me in thanking Harald M. Stauss, M.D., Ph.D., Director of Student Research & Professor of Pharmacology, for his leadership in making today's event a success. It is my hope that you will engage with our student researchers and their mentors to learn both about their current projects and the ongoing investigative endeavors of the Burrell College Research Laboratories.

John L. Hummer, MHA
President & Co-Founder
Burrell College of Osteopathic Medicine
E-mail: jhummer@burrell.edu

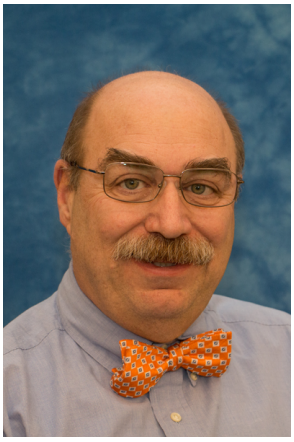
Dean's Welcome Address

It gives me great pleasure to recognize the many students who traded their summer break for an opportunity to further their own education in the field of research. This year's Summer Research Program encompasses investigations in population health, including infectious disease prevention, human physiology, anatomy, pathology and clinical medicine, a testimony to the varied interests of our students and their faculty mentors.

I am encouraged to see those interested in becoming the next generation of physician-scientists helping advance our medical knowledge for the benefit of our profession and our patients. Please join me in appreciating their enthusiasm to share the skills and knowledge they have gained from this experience.

William Pieratt, DO, FACP
Dean and Chief Academic Officer
Burrell College of Osteopathic Medicine
E-mail: bpieratt@burrell.edu

Assistant Dean for Research Welcome Address



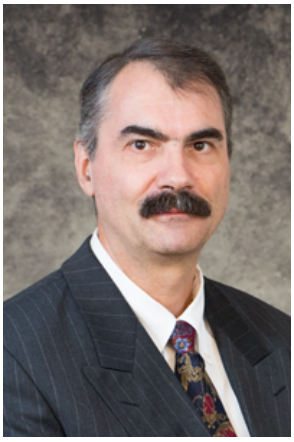
Each year we gather to hear presentations on the research and creative scholarly work performed by our student researchers under the guidance of faculty mentors. The 6^{th} Annual Medical Student Research Day marks both the culmination of our Summer Research Experience and the beginning of a life-long passion for inquiry for our student researchers, many of whom have just completed their first formal research project. The scholarly work presented covers a wide variety of topics that includes clinical case reports, anatomical research, computational modeling, social and behavioral science, field biology disease surveillance, medical education topics, and more. In general the purpose of today is to provide both formal and informal opportunities for discussion centered on "the life of the mind." I encourage you to visit each poster, to speak with the authors, and to learn more about the numerous intellectual pursuits of our students and faculty.

I wish to acknowledge the efforts of our faculty who so generously give their time to involve student in their scholarly work. Your commitment, expertise, and mentorship makes student research opportunities at the College possible. I also wish to acknowledge our Director of Student Research, Dr. Harald Stauss for leading our student research initiatives and the members of the Office of Research team, Ms. Cynthia Peraza, Ms. Kalli Martinez, and Ms. Kim Altamirano whose behind the scenes work keeps the research operations of the College running smoothly.

Thank you for attending the 2023 Medical Student Research Day! It is my hope that the scholarly discussions continue well beyond the events of the day.

Joseph N. Benoit, Ph.D.
Assistant Dean for Research
Professor of Physiology & Pathology
E-mail: research@burrell.edu

Director of Student Research Welcome Address



Welcome to this year's Medical Student Research Day!

At Medical Student Research Day, we celebrate the accomplishments of our students in research and scholarly activity. Medical Student Research day is also the culmination of the six-week Summer Research Experience at Burrell College. This summer 33 Burrell students participated in eleven different Summer Research Experience projects led by seven faculty. Throughout the summer, students also participated in seminar presentations by Dr. Teri Orr from the Biology Department at NMSU and Dr. Gabriel Frietze from the School of Pharmacy at UTEP. The seminar presentations were preceded by journal club sessions, during which students discussed publications by the seminar speakers. These were stimulating sessions, and I was pleased to see our students engage in highly thoughtful discussions related to reproductive traits and vaccine acceptability.

This year, we extended Medical Student Research Day to include scholarly work originating from the Distinction in Anatomy program and clinical rotation sites. With the start of new programs at Burrell College, such as the Mission Medicine program and the Distinction in Rural Health program, I am looking forward to a substantial growth in scholarly activities in the months and years to come. The inclusion of these programs resulted in 20 abstract submissions related to diverse topics, including public health, infectious disease prevention, COVID, stress and the HPA-axis, exercise science, pathology, and clinical medicine.

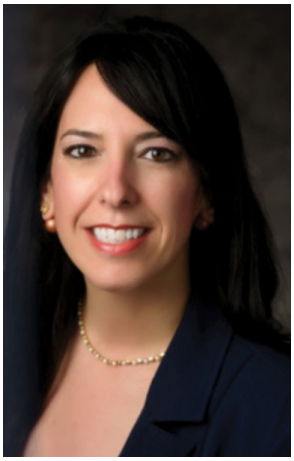
As the Director of Student Research, I would like to commend all faculty mentors who volunteered their time during the Summer to provide an outstanding research experience to our students. The faculty commitment to student research reflects the spirit at Burrell College where staff members, administrators, faculty, and senior leadership work together to provide the best medical school experience for our students. With this, I would like to thank the team of the Research Office, Dr. Benoit, Ms. Kalli Martinez, Ms. Kim Altamirano, and Ms. Cynthia Peraza, for making the Summer Research Experience and Medical Student Research Day possible.

In closing, I wish all students, mentors, and participants a successful Medical Student Research Day 2023!

Harald M. Stauss, MD, PhD
Professor of Pharmacology
Director of Student Research
E-mail: hstauss@burrell.edu

Keynote Speaker

Dr. Analia S. Loria-Kinsey, PhD



Dr. Analia S. Loria-Kinsey, PhD, is an associate professor in the University of Kentucky's College of Medicine Department of Pharmacology and Nutritional Sciences. She studies cardiovascular disease and strives to raise awareness about preventative measures and treatments.

Dr. Loria-Kinsey's research interest centers around the long-term effects of stressors during early life on cardiovascular disease risk using animal models. Recently, she also started investigating the mental and physiological effects in the offspring from mothers exposed to opioids during pregnancy. The ultimate goal of her studies is to identify reversible pathways associated to the programming of the cardiometabolic function.

By training Dr. Loria-Kinsey is a cardiovascular physiologist. Her interest in the study of sexual dimorphism on blood pressure regulation started during her PhD training. She started attending American Heart Association meetings on hypertension early on in her career, and was invited to participate in the Go Red for Women Symposium. During those years, women's inclusion in research and addressing sex as a biological variable in National Institutes of Health (NIH) grants became more prominent. When she moved to the University of Kentucky in 2013, she initiated a highly successful annual symposium, "Healthy Hearts for Women".

Dr. Analia S. Loria-Kinsey, PhD
Associate Professor of Pharmacology and Nutritional Sciences
College of Medicine - University of Kentucky
Lexington, KY 40536
E-mail: analia.loria@uky.edu

Program

7:30-8:30 Poster Setup, Room 208

7:30-8:30 Meet the Keynote Speaker, Dr. Loria-Kinsey, Room 152/153, Breakfast provided

Opening Ceremony **Lecture Hall 1 (Room 160)**

8:30-8:40 President's Welcome Address

8:40-8:50 Dean's Welcome Address

8:50-8:55 Assistant Dean of Research Welcome Address

8:55-9:00 Director of Student Research Welcome Address

Poster Session 1: Stress, Autonomic Nervous System, and Steroids **Room 208**

Authors are required to be available at their posters during the indicated time to present to the judges. Coffee will be served during poster viewing.

9:10-10:50 [P01] Impacts of Acute or Repeated Restraint Stress on the Female Hippocampus
Melissa Danikowski, Annique McLune, Elizabeth Kemp, and Philip Grenley
Mentor: Kristin L. Gosselink, PhD
Department of Physiology and Pathology, Burrell College of Osteopathic Medicine, Las Cruces, NM

9:40-11:20 [P02] Ability of Surf Therapy to Promote Stress Coping in Adult Women
Elizabeth Kemp, Philip Grenley, Melissa Danikowski, and Annique McLune
Mentor: Kristin L. Gosselink, PhD
Department of Physiology and Pathology, Burrell College of Osteopathic Medicine, Las Cruces, NM

10:10-11:30 [P03] Effects of Occipito-Atlantal Decompression and Transcutaneous Auricular Vagus Nerve Stimulation on Autonomic Modulation of Cardiac Function
Jumana Roufail and Joseph Prokop; Mentor: Harald M. Stauss, MD, PhD
Department of Biomedical Sciences, Burrell College of Osteopathic Medicine, Las Cruces, NM

10:30-11:50 [P04] Transcutaneous Auricular Vagus Nerve Stimulation Inhibits Stress-induced Cortisol Secretion
Ely Cuberos Paredes, Sadie Mak, Domenica Goyes, Raffi Yardimian, and Nickolas Ortiz
Mentor: Harald M. Stauss, MD, PhD
Department of Biomedical Sciences, Burrell College of Osteopathic Medicine, Las Cruces, NM

10:30-11:50 [P05] Translating a Historic Fluorometric Assay to Measure Cortisol Concentrations into the 21th Century
Rami Radwan and Lillian Wang; Mentor: Harald M. Stauss, MD, PhD
Department of Biomedical Sciences, Burrell College of Osteopathic Medicine, Las Cruces, NM

Poster Session 2: Public Health, Infectious Disease/COVID **Room 208**

Authors are required to be available at their posters during the indicated time to present to the judges. Coffee will be served during poster viewing.

9:10-10:50 [P06] Borderplex Clinical Trial Network (CTn) Pilot Program
Gabriel Garcia; Mentor: Joseph N. Benoit, PhD
Department of Physiology and Pathology, Burrell College of Osteopathic Medicine, Las Cruces, NM

9:30-10:30 [P07] Contributions of Social Determinants of Health to Postoperative Opioid Prescribing
Rebecca Nika Tsai; Mentor: Mark C. Bicket, MD, PhD
University of Michigan, School of Public Health, Ann Arbor, MI

9:10-10:50 [P08] The Spore in the Desert, Investigating the Distribution of *Coccidioides* in Southern New Mexico
Kyle Brice, Michael Schmidt, Einya Densmore, and Isaac Myszkowski
Mentor: Michael Woods, PhD
Department of Physiology and Pathology, Burrell College of Osteopathic Medicine, Las Cruces, NM

9:40-11:20 [P09] Healthcare Provider Perceptions and Behaviors May Influence HPV Vaccine Uptake in the El Paso/Doña Ana County Community
Onyinyechi G. Nwosu and Megan E. Sampath
Mentor: Kristin L. Gosselink, PhD
Department of Physiology and Pathology, Burrell College of Osteopathic Medicine, Las Cruces, NM

10:30-11:50 [P10] Development of a Loop-Mediated Isothermal Amplification Assay for the Detection of Human Papillomaviruses 16 and 18
Hari Koganti and Travis Quillin; Mentor: Debra Bramblett, PhD
Department of Biomedical Sciences, Burrell College of Osteopathic Medicine, Las Cruces, NM

9:40-11:20 [P11] The Role of Medication, Mental Illness, and Social Isolation on the Development of the Fetus in the Context of the COVID-19 Pandemic
Zayna Abdulla and Aleena Ferozuddin; Mentor: Angelica Oviedo, MD
Department of Physiology and Pathology, Burrell College of Osteopathic Medicine, Las Cruces, NM

9:10-10:50 [P12] Detecting SARS-CoV-2 in Bats of New Mexico using Immunohistochemistry on Formalin-Fixed, Paraffin-Embedded Tissues
Eric Babb and Amelia N. Hidalgo; Mentor: Thomas Eiting, PhD
Department of Physiology and Pathology, Burrell College of Osteopathic Medicine, Las Cruces, NM

9:10-10:50 [P21] The Microbiology and Treatment in a Rare Case of Bedbug Induced Normocytic Anemia
Atish Anit Kumar, Shalvi Prasad, Ariel Hurwitz
Mentors: Marc Benson, PhD and Sepehr Khashaei, MD
Department of Biomedical Sciences, Burrell College of Osteopathic Medicine, Las Cruces, NM

Poster Session 3: Pathology and Clinical Medicine **Room 208**

Authors are required to be available at their posters during the indicated time to present to the judges. Coffee will be served during poster viewing.

10:10-11:30 [P13] Screening Publicly Available CT Datasets of the Head for Potential Use in Studying Normal and Pathological Issues Related to Nasal Airflow
Kailey Simonson and Ruchy Aggarwal; Mentor: Thomas Eiting, PhD
Department of Physiology and Pathology, Burrell College of Osteopathic Medicine, Las Cruces, NM

10:30-11:50 [P14] Quantification of Budesonide Retained in the Sinonasal Cavity After High-volume Saline Irrigation in Post-operative Chronic Rhinosinusitis and Healthy Subjects
Paige Shipman; Mentors: Abigail Pulsipher, PhD and Kristine A. Smith, MD
University of Utah, Salt Lake City, UT

9:30-10:30 [P15] Ischemic Fasciitis: A Rare Pseudosarcomatous Dermatological Diagnosis
Atish Anit Kumar, Nandini Patel, and Christian Crawford; Mentors: Gabor Szalai PhD, Shalvi Prasad DPM PGYII, David Hyer DPM, and Sarah Mele DPM
Burrell College of Osteopathic Medicine, Las Cruces, NM

10:10-11:30 [P16] Pelvis and Lower Extremity Fractures Related to 4-wheeled Off-road Vehicles: Trends from the NEISS Database
Alejandro Esparza, Charlotte Lenz, Elizabeth Rivenbark and Chloe Meyers
Mentors: Jordan Johnson, DO and G. Robert Cummings, DO
MountainView Regional Medical Center, Orthopaedic Surgery, Las Cruces, NM

10:10-11:30 [P17] Preventative Effect of Non-steroidal Anti-inflammatory Drug Use and Impact of Floor Exercise Equipment on Achilles Tendon Ruptures in Female Collegiate Gymnasts
Emily C. Muhlenhaupt; Mentor: Harald M. Stauss, MD, PhD
Department of Biomedical Sciences, Burrell College of Osteopathic Medicine, Las Cruces, NM

Poster Session 4: Anatomy and Medical Education **Room 208**

Authors are required to be available at their posters during the indicated time to present to the judges. Coffee will be served during poster viewing.

9:40-11:20 [P18] Sex-Based Differences in the Incidence of Dual-Chamber Cardiac Implantable Devices
Rhea Kohli and Grace Hawley
Mentors: Jon Jackson, PhD, Bonny Ford, PhD, Carlos Soneira-Ruiz, MD, MS, Nancy Minugh-Purvis, PhD, and Kristopher Vaudrey, MA
Department of Anatomy & Cell Biology, Burrell College of Osteopathic Medicine, Las Cruces, NM

9:40-11:20 [P19] Observations from a Post-radical Mastectomy Cadaver: Radical Mastectomy too Radical?
Rose-Mary Colon, Andie Evans, Mohini Vadalia, and Victoria Vicuña
Mentors: Bonny Ford, PhD and Jon Jackson, PhD
Department of Anatomy & Cell Biology, Burrell College of Osteopathic Medicine, Las Cruces, NM

9:10-10:50 [P20] Utilization of ChatGPT to Enhance Medical Education
Maha Ali, Nicholas Hunt, Khanhtran Anna Levu, and Samuel Stewart
Mentor: Joseph N. Benoit, PhD
Department of Physiology and Pathology, Burrell College of Osteopathic Medicine, Las Cruces, NM

Noon-1:00 Lunch Break (Buffet provided, Back Patio)

Keynote Lecture **Lecture Hall 1 (Room 160)**

1:00-2:00 Dr. Analia S. Loria-Kinsey, PhD
Associate Professor of Pharmacology and Nutritional Sciences, College of Medicine - University of Kentucky, Lexington, KY
The Opioid Crisis and Childhood Adversity in America: What Are We Overlooking?

Award Finalist Presentations: **Lecture Hall 1 (Room 160)**

The judges of the poster competition will select finalists to present during this session.
Moderator: Harald M. Stauss, MD, PhD

2:00-2:10 Finalist Presentation 1

2:10-2:20 Finalist Presentation 2

2:20-2:30 Finalist Presentation 3

2:30-2:40 Finalist Presentation 4

2:40-2:50 Finalist Presentation 5

2:50-3:00 Finalist Presentation 6

3:00-3:15 Group Photo at Fountain

3:15-4:30 Reception with Award Presentations, Room 152/153

Abstracts - Session 1

Impacts of Acute or Repeated Restraint Stress on the Female Hippocampus

Melissa Danikowski, Annique McLune, Elizabeth Kemp, and Philip Grenley
Mentor: Kristin L. Gosselink, PhD

Context: The brain mediates bodily responses to stress by integrating related stimuli and regulating subsequent outputs. Acute and repeated stress exposures differently affect the hypothalamic-pituitary-adrenal (HPA) axis and higher brain centers. Specifically, the hippocampus has been identified as a region that can modify stress responses.[1,2] Hippocampal structure differs in females compared to males[3], which may partially explain sex differences in stress responding.
Objective: To quantify the levels of neuronal activation, in terms of Fos protein expression, in the hippocampus of female rats exposed to either acute or repeated restraint stress at night. Additional objectives were to compare our findings with those from male rats stressed at night, and from female rats stressed during the daytime when endogenous corticosterone levels are low.
Methods: Adult female rats ($\sim$3 mo. of age) were randomly assigned to Control, Acute or Repeated restraint stress groups. Repeatedly restrained rats were enclosed in plastic restrainers daily (30 min/d) for 14d. Acutely restrained rats were exposed to open restrainers daily for 13d, then restrained for 30 min on the 14th day only. Control rats were handled and exposed to the restrainers for 30 min/d on each of the 14d of the study, but never restrained. Rats were stressed near the beginning of the dark phase of the light cycle (1800-2000 h). Two hours after their only or final restraint session, rats were deeply anesthetized and transcardially perfused with 4% paraformaldehyde. Brains were dissected, postfixed for 5h, and cryoprotected overnight at 4°C. The next day, five 1:5 series were cut at 30µm on a freezing tabletop microtome, and sections stored in antifreeze at -20°C. Immunohistochemical staining for Fos involved treatment of the sections with 0.3% hydrogen peroxide, 0.1% sodium borohydride, and placement into a primary antibody solution (rabbit anti-Fos, 1:10K; Abcam) overnight at room temperature with gentle shaking. The following day, sections were incubated in secondary antibody (biotinylated goat anti-rabbit IgG, 1:200; Vector). An avidin-biotin-complexing solution (Vectastain Elite kit; Vector) was applied, and specific binding was localized using a peroxidase method with diaminobenzidine as a chromogen. The number of Fos-expressing cells was quantified by simple cell counting with a light microscope-coupled camera and ImageJ software. Counts were taken from 4 sections through the hippocampus and summed for each animal. Whole hippocampus was analyzed, as were the CA1, CA2 and CA3 subregions and the dentate gyrus. Group means were calculated and compared by t-test, with significance determined at the $p \leq 0.05$ level.
Results: Acute stress significantly decreased the number of Fos-expressing neurons in the hippocampus of female rats, compared to the number seen in Control (unstressed) animals. Repeated restraint, in contrast, resulted in Fos counts that were higher than those seen after acute stress exposure. Fos levels in the repeatedly stressed hippocampus were also higher than in Control hippocampus sections. When subregions of the hippocampus were considered separately, the CA1, CA3 and dentate gyrus areas all showed a similar pattern to the whole hippocampus, with acute stress significantly decreasing Fos expression. Only in the CA2 region was there a trend between the number of Fos-expressing neurons increasing when comparing repeated stress to the control, but our methods likely overestimated the amount of tissue in this area.

Conclusion: Our data and interpretations are limited by the small "n" per group at this time, but we have consistently seen that acute restraint stress at night reduces neuronal activation in the female rat hippocampus. Repeated stress exposure, on the other hand, leads to the activation of a larger number of hippocampal neurons than either Control or Acute stress conditions. This was true for whole hippocampus as well as the individual CA1, CA3 and dentate gyrus regions. Initially, we hypothesized that the acute restraint stress would have a larger number of Fos-expressing neurons but this was not found to be true. We conclude that acute stress may decrease the activation of neurons in the hippocampus under times of acute stress so that inhibitory control of the HPA axis is removed when the stress response (and corticosterone secretion) needs to be large. With repeated exposure to a stressor of the same type, the animal may learn that the stimulus is not life-threatening and may allow hippocampal control of the HPA axis to increase. Data from male rats and from day-stressed female rats will be evaluated and compared to our current data.

References:

1. McEwen B. S. (2007). *Physiology and neurobiology of stress and adaptation: central role of the brain*. Physiological reviews, 87(3), 873–904. https://doi.org/10.1152/physrev.00041.2006

2. Olave, F. A., Aguayo, F. I., Román-Albasini, L., Corrales, W. A., Silva, J. P., González, P. I., Lagos, S., García, M. A., Alarcón-Mardones, M., Rojas, P. S., Xu, X., Cidlowski, J. A., Aliaga, E., & Fiedler, J. (2022). *Chronic restraint stress produces sex-specific behavioral and molecular outcomes in the dorsal and ventral rat hippocampus*. Neurobiology of stress, 17, 100440. https://doi.org/10.1016/j.ynstr.2022.100440

3. Shors, T. J., Chua, C. and Falduto, J. (2001). *Sex Differences and Opposite Effects of Stress on Dendritic Spine Density in the Male Versus Female Hippocampus*. Journal of Neuroscience 21(16), 6292-6297; https://doi.org/10.1523/JNEUROSCI.21-16-06292.2001

Ability of Surf Therapy to Promote Stress Coping in Adult Women

Elizabeth Kemp, Philip Grenley, Melissa Danikowski, and Annique McLune
Mentor: Kristin L. Gosselink, PhD

Context: It is generally accepted that stress impairs health, but understanding in the field is limited by the numerous variables that factor into "real" and "perceived" stressors and occur across the lifespan (1). An array of therapy types have been employed to cope with stress, with nature-based therapies gaining recognition in recent years (3). One of these, surf therapy, has been shown to have significant psychological benefits and produce greater improvements in women compared to men (2).

Objective: To examine the ability of a surf therapy program to improve overall wellness and decrease perceived stress scores in adult women. In addition, this pilot study will assess whether the degree of program success correlates with perceived stress scores, actual/cumulative stress experiences, or both.

Methods: Adult women who voluntarily enroll in an established surf therapy program will be invited to participate in a survey to determine stress levels and history along with psychological assessments. We anticipate that up to 30 individuals who are aged 18 and over and identify as women will be recruited to the project. Participants will live and be recruited from communities in Southern California, following the standards already set by the Groundswell Community Project. After consenting to participate, these individuals will provide demographic information and information on relevant prior life events including an adverse childhood experiences (ACE) score, a cumulative stress evaluation, and a reflection on the impact of the recent Covid-19 pandemic. Each participant will then undergo a 4- to 8-week program of surf therapy that includes journaling activities, group sessions, and engagement with the water according to their comfort level. Physical and psychological safety will be assured by the presence of trained counselors and lifeguards. It is expected that participants will not undergo any other forms of therapy during this program. Before (pre-test) and after (post-test) the surf therapy program, as well as 3-4 months following program termination, participants will complete an online survey to evaluate mood, coping with stress and other challenges, self-talk, closeness to nature, and perceived stress levels. Surveys will be deployed electronically, and may be completed on a program-provided tablet or other personal device. Participants will be assigned a unique code to protect identifying information. Debriefing material containing resources and guidance for additional support, if needed, will be provided at the completion of each survey.

Results: Approval by the Institutional Review Board is pending, so we have not yet been able to generate or analyze data on this project. As prior studies have demonstrated the effectiveness of surf therapy and its particular strength in improving wellness in women, we expect our study to have similar findings. It is anticipated that perceived stress levels will be significantly lower at the end of the surf therapy program compared to the beginning. The novelty of our approach will consider how actual or cumulative stress relates to current levels of perceived stress in each individual, and whether either or both aspects of this stress history may impact the success of the surf therapy program.

Conclusion: Limitations of the study include its reliance on self-reporting of information, and the possibility that not all participants will complete the entire study. Participants may have varied stress histories and demographics, making it difficult to find statistically significant differences in

our analyses. On the other hand, participants may be similar in terms of income or other social or work factors such that they are able to participate in a program of this type. Data from this pilot study will inform future work on stress, resilience and coping in women, allowing for eventual comparison with men or across other groups so that the utility of this program can be evaluated and we may be able to predict who might benefit most from a program of this type. Our findings will provide a better understanding of the impacts of acute versus chronic stress, and will lead to deeper assessments of stress responses including physiological measures such as heart rate variability and salivary cortisol levels as a means to support stress management by participants.

References:

1. Epel ES, Crosswell AD, Mayer SE, Prather AA, Slavich GM, Puterman E, Mendes WB. *More than a feeling: A unified view of stress measurement for population science*. Front Neuroendocrinol. 49: 146-169, 2018. doi: 10.1016/j.yfrne.2018.03.001.

2. Glassman LH, Otis NP, Michalewicz-Kragh B, Walter KH. *Gender Differences in Psychological Outcomes Following Surf Therapy Sessions among U.S. Service Members*. Int J Environ Res Public Health 18(9): 4634, 2021. doi:10.3390/ijerph18094634

3. Stigsdotter UK, Corazon SS, Sidenius U, Nyed PK, Larsen HB, Fjorback LO. *Efficacy of nature-based therapy for individuals with stress-related illnesses: randomised controlled trial*. Br J Psychiatry 213(1): 404-411, 2018. doi: 10.1192/bjp.2018.2.

Effects of Occipito-Atlantal Decompression and Transcutaneous Auricular Vagus Nerve Stimulation on Autonomic Modulation of Cardiac Function

Jumana Roufail and Joseph Prokop
Mentor: Harald M. Stauss, MD, PhD

Context: During the time it takes you to read this abstract, about ten Americans will pass away from cardiovascular diseases (CDC). While the sympathetic nervous system has been a target for treatment of many cardiovascular disorders, the parasympathetic nervous system has been largely neglected as a potential therapeutic target. This is surprising, because many cardiovascular conditions are characterized by autonomic dysregulation with increased sympathetic and decreased parasympathetic activity[1−5].

Objective: To identify non-invasive techniques to restore parasympathetic nervous system function in patients with cardiovascular diseases and other chronic disease conditions. Our hypothesis was that occipito-atlantal decompression (OA-D) and transcutaneous auricular vagus nerve stimulation (taVNS) increase cardiac parasympathetic modulation. If this hypothesis proves to be correct, these non-invasive techniques could potentially be used to restore parasympathetic function in chronic disease conditions.

Methods: The study was approved by the Institutional Review Board. All subjects gave written informed consent. The experimental protocol consisted of a 30-min baseline, 5 min OA-D, 15 min taVNS, or 15 min rest (control intervention, CTR). A final 30 min recovery period followed. The protocol was repeated on three consecutive days for each study participant. A total of 59 studies were conducted in 45 adult individual participants (some subjects participated in several groups). Exclusion criteria included pregnancy, any findings that would hinder the effectiveness or increase the risk associated with OA-D, any medication or medical condition that interferes with the autonomic nervous system, chronic diseases, and current drug or alcohol abuse. From each of 177 EKGs (3 days, 59 studies), beat-by-beat heart rate was extracted using the freely available HemoLab software[6] at baseline, intervention, and recovery. This resulted in a total of 531 time series. Artifacts, including abnormal heart beats (e.g., PVCs) were manually replaced by interpolated values. From these cleaned 531 time series, the following heart rate variability (HRV) parameters were calculated: Standard deviation of all NN intervals (SDNN), square root of the mean of the sum of the squares of differences between adjacent NN intervals (RMSSD), absolute low frequency spectral power of HRV (LF_{HR}), absolute high frequency of spectral power of HRV (HF_{HR}), and the LF_{HR} to HF_{HR} ratio. For statistical data analysis the HRV parameters were log-transformed because HRV parameters are not normally distributed. To compare data between baseline, intervention, and recovery periods, a one-way analysis of variance (ANOVA) for repeated measures was conducted individually for each of the three groups (OA-D, taVND, or CTR). Comparisons between groups were done by one-way ANOVA for independent measures. Data are presented as means±SEM. Statistical significance was assumed for an alpha error (P-value) of less than 0.05.

Results: Throughout the experimental protocol, heart rate significantly (P<0.05) declined in all groups (change from baseline to recovery: CTR: -1.7±0.5 bpm; OA-D: -2.8±0.8 bpm; taVNS: -3.3$\pm$0.6 bpm). This decline in heart rate tended to be greater in the taVNS group compared to the CTR group (P=0.10). Throughout the protocol, no significant changes from baseline were observed in SDNN, RMSSD, LF_{HR}, or HF_{HR} in the CTR group. However, overall HRV expressed as SDNN increased significantly from baseline to recovery in the OA-D (+11.2±4.7 bpm, P<0.05) and

taVNS (+5.9±1.2 bpm, P<0.05) groups, but not in the CTR group (+0.9±1.7 bpm, n.sig.). RMSSD, a time-domain HRV measure that is generally considered a marker for parasympathetic cardiac modulation[7,8], increased significantly from baseline to recovery only in the taVNS group (+4,4±0.7 bpm, P<0.05). LF_{HR}, a frequency-domain HRV measure that is generally considered a marker for sympathetic and parasympathetic cardiac modulation[7,8], tended to increase in the OA-D group (+1.5±0.8 bpm, P=0.06), and increased significantly in the taVNS group (+0.54±0.28, P<0.05), but did not change in the CTR group (-0.40±0.27, n.sig.). HF_{HR}, a frequency domain HRV measure that is generally considered a marker of parasympathetic modulation of cardiac function[7,8], increased significantly only in the taVNS group (+0.48±0.20 bpm, P<0.05), but not in the OA-D group (+0.29±0.33 bpm, n.sig.) or the CTR group (-0.28±0.22 bpm, n.sig.). The LF_{HR} to HF_{HR} ratio is a measure of autonomic balance with high values indicating sympathetic dominance and low values indicating parasympathetic dominance[7,8]. LF_{HR} to HF_{HR} ratio did not change significantly in the CTR (-0.24±0.42, n.sig.) and OA-D (+0.21±0.21, n.sig) groups. However, in the taVNS group LF_{HR} to HF_{HR} ratio decreased significantly from baseline to recovery (-0.31±0.21, P<0.05), suggesting that taVNS shifted autonomic balance towards parasympathetic dominance.

Conclusion: In summary, HRV analysis revealed that both OA-D and taVNS increased overall HRV as indicated by the significant increase in SDNN during the recovery period compared to the baseline period. In the OA-D group, this increase in overall HRV appears to be mostly mediated by increased cardiac sympathetic modulation, because RMSSD and HF_{HR} that mostly reflect parasympathetic cardiac modulation did not change. In contrast, in the taVNS group, the increase in overall HRV might be mediated by a co-activation of cardiac sympathetic and parasympathetic modulation, because LF_{HR} as well as RMSSD and HF_{HR} increased significantly. Even though our data is compatible with a co-activation of cardiac sympathetic and parasympathetic activity with taVNS, it appears that parasympathetic modulation dominates, because the LF_{HR} to HF_{HR} ratio decreased significantly following taVNS. Our findings provide a rationale for exploring non-invasive taVNS as a potential therapeutic modality to restore parasympathetic function in chronic disease conditions and potentially improve the quality of life of patients with chronic disease conditions.

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Transcutaneous Auricular Vagus Nerve Stimulation Inhibits Stress-induced Cortisol Secretion

Ely Cuberos Paredes, Sadie Mak, Domenica Goyes, Raffi Yardimian, and Nickolas Ortiz
Mentor: Harald M. Stauss, MD, PhD

Context: Previous studies suggested that transcutaneous auricular vagus nerve stimulation (taVNS) elicits anti-inflammatory effects[1]. It has been speculated that activation of the hypothalamic-pituitary-adrenal (HPA) axis, including cortisol release, contributes to these effects[2]. A better understanding of the mechanisms contributing to the anti-inflammatory actions of taVNS may potentially provide a mechanistic rationale for using taVNS for the treatment of chronic inflammatory conditions.

Objective: To assess the impact of taVNS on stress-induced cortisol secretion. Specifically, the hypothesis was tested that stress-induced cortisol secretion is augmented by taVNS.

Methods: The study was approved by the Institutional Review Board and all study participants provided written informed consent. Exclusion criteria included pregnancy, medical conditions that hinder effectiveness or increase the risk of taVNS, medications or medical conditions that interfere with the autonomic nervous system or immune system. The study was designed as a randomized crossover study. Adult healthy participants (n=12) reported for two experimental sessions (for taVNS or sham-taVNS) on two different days, a minimum of four days apart. Throughout the protocol, subjects were in the supine position and the EKG was recorded continuously. After an initial 15-minute rest period a saliva sample (B1) was obtained. After an additional 15-minute rest period a second baseline saliva sample (B2) was obtained. Then, taVNS or sham-taVNS was started and continued for 30 min. Ten minutes into taVNS or sham-taVNS, a third saliva sample (VNS1) was obtained. This was followed by a 15-min mental arithmetic stress application[3,4] during which taVNS or sham-taVNS was continued. Immediately after the 15-min stress application a post-stress saliva sample was obtained (PS). The taVNS or sham-taVNS was stopped five minutes after the stress application and a fifth saliva sample (VNS2) was obtained. Four more recovery saliva samples (R1-R4) were collected.

Saliva samples were analyzed for cortisol concentration by enzyme linked immunosorbent assay (ELISA). Heart rate, extracted from the EKG was used as a measure of the cardiovascular stress-response to the mental arithmetic stress test and heart rate variability was determined to assess the effects of taVNS on cardiac autonomic tone. Statistical analysis was performed by two-way ANOVA for two repeated measures (experimental condition, i.e., taVNS vs sham-taVNS and time point during the experimental protocol, i.e., B1, B2, VNS1, PS, VNS2, and R1-R4). An alpha error (P-value) of <0.05 was considered statistically significant.

Results: Heart rate significantly increased in response to mental arithmetic stress in both experimental conditions (sham-taVNS: +6.9$\pm$2.5 bpm, $P<0.05$; taVNS: +5.5$\pm$2.7 bpm, $P<0.05$). During the recovery period (time points R1-R4), heart rate returned to baseline levels in response to sham-taVNS but decreased significantly below baseline levels in response to taVNS (R1: -4.5$\pm$1.1 bpm, $P<0.05$; R2: -4.3$\pm$1.0 bpm, $P<0.05$; R3: -4.4$\pm$1.2 bpm; R4: -3.6$\pm$1.3 bpm, $P<0.05$). Overall heart rate variability expressed as SDNN increased significantly by arithmetic stress in both experimental conditions (sham-taVNS: +24.9$\pm$14.4 bpm, $P<0.05$; taVNS: +12.9$\pm$7.4 bpm). The significant increase in heart rate and overall heart rate variability with mental arithmetic stress confirms that this intervention indeed activated the sympathetic nervous system. The significant reduction in heart rate during the recovery period following taVNS but not during sham-taVNS, is consistent with the notion that taVNS increases parasympathetic and/or reduces sympathetic nervous system activity.

Initial baseline levels of salivary cortisol were 1.3$\pm$0.3 ng/mL for the sham-taVNS condition and 1.4$\pm$0.4 ng/mL in the taVNS condition. Throughout the time course of the experimental protocol cortisol levels declined to final levels at R4 of 0.84$\pm$0.15 ng/mL ($P<0.05$) for the sham-taVNS condition and 0.85$\pm$0.21 ng/mL ($P<0.05$) for the taVNS condition. In the sham-taVNS condition, this decline in cortisol was delayed by the stress application and was only statistically significant following the arithmetic stress test (-2.4$\pm$0.22, $P<0.05$ at VNS2). However, in the taVNS condition, the decrease in salivary cortisol concentration was already statistically significant during the stress application (-0.55$\pm$0.19, $P<0.05$ at VNS1). This finding suggests that taVNS inhibits cortisol release in response to the arithmetic stress test.

Conclusion: Our data demonstrates that sympathetic activation by mental arithmetic stress, as confirmed by an increase in heart rate and heart rate variability, delayed the decline in salivary cortisol levels only in the sham condition, but not when taVNS is applied. This finding contrasts with our initial hypothesis and suggests that taVNS inhibits stress-induced adrenal cortisol release. Our finding that heart rate was reduced during the recovery period compared to baseline in the taVNS condition but not by sham-taVNS suggests that taVNS increased parasympathetic and/or reduced sympathetic tone. It is possible that decreased adrenal sympathetic tone in response to taVNS mediates the suppression of cortisol release. It is well known that many chronic inflammatory conditions, such as psoriasis or Crohn's disease worsen if patients are exposed to elevated levels of chronic stress. It is possible that taVNS does not only reduce the cortisol response to stress but also inhibits the release of inflammatory mediators, such as pro-inflammatory cytokines, including TNF-α. In fact, our previous study[1] demonstrated reduced salivary TNF-α levels in response to taVNS.

Our results provide a rationale for future studies investigating the anti-inflammatory effects of taVNS in chronic inflammatory diseases. This concept is particularly attractive, because taVNS is a non-invasive and inexpensive technique that patients can apply on their own in their home environment.

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Translating a Historic Fluorometric Assay to Measure Cortisol Concentrations into the 21th Century

Rami Radwan and Lillian Wang
Mentor: Harald M. Stauss, MD, PhD

Context: In 1962, before the invention of enzyme-linked immunoassays (ELISAs), Mattingly established an assay to measure cortisol in human plasma based on the fluorescence emitted by cortisol in a strong acid.[1] This historic assay has many advantages over the ELISA technique, including time-efficiency and cost-effectiveness. However, it required large plasma volumes and – due to the available equipment at the time – was limited to analyzing only six samples at a time.
Objective: To overcome the limitations of the historic assay by reducing the required plasma volume and adopting the assay to fit in 96-well microtiter plates, which would allow the running of large numbers of samples in a single assay using a modern microplate fluorometer. In addition, the sensitivity of the assay was optimized to allow precise measurements in small sample volumes of only 70 µL compared to 2 mL in the historic protocol by Mattingly.
Methods: Briefly, the original assay required only two steps: (1) cortisol extraction from the plasma (or saliva) sample; (2) the fluorescence reaction. For the first step, the sample is gently mixed with methylene chloride in a ratio of 1:7.5 (2 mL plasma in 15 mL methylene chloride). By reducing this ratio (less methylene chloride for a given plasma volume) we can increase the concentration in the cortisol extract, providing a higher sensitivity of the assay. Thus, in the first part of the study, we determined the sensitivity of the assay with methylene chloride to sample ratios of 1:7, 1:6, 1:5, 1:4, 1:3, and 1:2, using 100 µL of cortisol standard in 700, 600, 500, 400, 300, or 200 µL of methylene chloride.
For the second step, the cortisol-methylene extract is mixed with a fluorescence reagent (75% concentrated sulfuric acid in 25% pure ethanol) in an original ratio of 2:1 (10 mL methylene chloride extract in 5 mL fluorescence reagent). By changing this ratio, the sensitivity of the assay may be further improved. Thus, in the second part of the study, we tested cortisol extract to fluorescence reagent ratios of 3:1, 2:1, 1:1, 1:2 and 1:3, using a total volume of 240 µL. Once the fluorescence reagent is mixed with the cortisol-methylene chloride extract, the fluorescence gradually builds up over time.
In the third part of the study, we determined the time after which the fluorescence enters a plateau phase and no longer increases. As the fourth part of the study, we minimized the volumes for both steps of the assay to not exceed 300 µL, which is the volume of the wells in the 96-well microtiter plates.
The final, fifth part of the study was to validate the assay against an ELISA assay by determining diurnal cortisol concentrations from 6:00 am to 9:00 pm in saliva samples obtained every 3 hours.
Results:
Optimal methylene chloride to sample volume ratio: Using standard cortisol dilutions of 10, 30, 50, 75, 100, 300, 500, 750, and 1000 ng/mL we determined the linear fluorescence to cortisol concentration relationships for various methylene chloride to cortisol standard ratios. Equally high fluorescence was obtained for methylene chloride to cortisol standard ratios of 2:1 and 3:1 (200 or 300 µL of methylene chloride to 100 µL of cortisol standard). Lower ratios, including 4:1, 5:1, 6:1, and 7:1 resulted in less fluorescence and, therefore, a lower sensitivity of the assay.
Methylene chloride extract to fluorescence reagent ratio: Consistent with the original protocol by

Mattingly, we determined that a methylene chloride to fluorescence reagent ratio of 2:1 provided the strongest fluorescence.

Timing of fluorescence development: Consistent with the historic report by Mattingly, we found a plateau in the fluorescence development after 20-30 minutes following adding the fluorescence reagent to the methylene chloride extract.

Adaption to 96-well microtiter plates: Based on the reagent ratios determined in the prior steps of the study, we opted for the following volumes when using 96 well microtiter plates that hold up to 300 µL per well. For the cortisol extraction, we used 70 µL of sample in 210 µL of methylene chloride. For the detection step, we used 120 µL of methylene chloride extract in 60 µL fluorescence reagent.

Validation of the assay: Saliva samples, collected at three-hour intervals between 6:00 am and 9:00 pm were analyzed using the optimized Mattingly protocol and by ELISA. Salivary cortisol levels rose from 6.1ng/mL (ELISA) and 4.8 ng/mL (Mattingly) at 6:00 am to 13.3 ng/mL (ELISA) and 12.0 ng/mL (Mattingly) at 9:00 am. Subsequently, salivary cortisol levels decreased to levels of 6.7 ng/mL (ELISA) and 6.3 ng/mL (Mattingly) at noon to 3.1 ng/mL (ELISA) and undetectable levels (Mattingly) at 6:00 pm and thereafter.

Conclusion: In summary, we improved the sensitivity of the historic cortisol assay by Mattingly by reducing the ratio of methylene chloride to sample volumes from the original ratio of 7.5:1.0 to 3.0:1.0 in the initial cortisol extraction step of the assay. We confirmed that a cortisol extract to fluorescence reagent ratio of 2:1 as originally proposed by Mattingly provides optimal fluorescence. Likewise, we also confirmed that a plateau in the fluorescence development occurs after 20-30 minutes. We also successfully adopted the assay to small volumes needed for the use of 96-well microtiter plates. Finally, we validated the optimized assay against the "gold-standard" ELISA assay by demonstrating that the assay detects the physiologic circadian variation in cortisol levels and by showing that the absolute concentrations are very close with both assays. While the sensitivity of the optimized assay is large enough to detect the higher morning cortisol levels in saliva, the assay is not sensitive enough to detect very low levels in the afternoon or evening. However, it is important to note that plasma levels of cortisol are 20 times higher than salivary levels and the sensitivity of the assay is high enough to detect plasma cortisol levels at any time of day. In conclusion, our optimized assay maintains the advantages of the historic assay, including time-efficiency and cost-effectiveness, while overcoming some of the limitations, such as the need for large sample volumes and the limitation of analyzing only six samples at a time.

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Abstracts - Session 2

Borderplex Clinical Trial Network (CTn) Pilot Program

Gabriel Garcia
Mentor: Joseph N. Benoit, PhD

Context: Clinical trial awareness and referrals amongst physicians do not adequately support available regional trials, even at large academic institutions geared toward promoting clinical trial activity. This is associated with physician's access to trial information, level of training in clinical research, time restrictions due to overwhelming professional responsibilities, and the current fragmented healthcare system which employs commercially approved Standard of Care (SoC) systems instead of innovative solutions.
Objective: To create and study the effectiveness of a community-based healthcare network for the region's healthcare providers, investigators, and community health workers (CHWs) to increase clinical trial awareness, engagement, and referral in the El Paso and Las Cruces patient populations.
Methods: The project is divided into three phases and is currently in its "Phase I" design objectives and methodology. The collaborative effort is being carried out by scientists from Burrell, Texas Tech University Health Sciences EP, UT Health, and the Medical Center of the Americas Foundation (MCA).

- **Phase I:** Study design, baseline data collection, Institutional Review Board (IRB) involvement
- **Phase II:** Analysis of local CTn pilot data
- **Phase III:** Final analysis, manuscript publication

Strategic Clinical Trial Framework:
The following strategic interventions will be leveraged to achieve the proposed objective [1]:

1. **Implement a Centralized Community Wide Mobile IT Platform to increase awareness, engagement, and referral.** Leverage a mobile IT platform (i.e., High Enroll) to centralize regional trial information to facilitate clinical trial awareness, engagement, and enrollment in the entire community healthcare ecosystem. High Enroll acts as a patient/provider-facing mobile application that grants access to clinical trial information and communication with trial team members, while giving research managers/coordinators web-based administrative access to manage their trial content. The app's capacity to provide several unidentified user metrics grants access to data points that will be used to analyze the pilot's objectives.

2. **Develop the Clinical Trial Network (CTn) through education, training, and support:** Proactively grow and support the number of providers and community liaisons comprising the program network who agree to receive the following program support:

   (a) **Community Health Workers (CHW's)** will be trained to enter an on-going dialogue with the community about clinical trials, their impact on community health and health outcomes, and how to refer patients having an interest in learning more as appropriate.

(b) **Healthcare Provider Training –** healthcare providers will be trained to use the mobile IT platform - how to find, share, and refer patients to clinical trials being conducted locally.

(c) **Ongoing Support –** CTn participants will be supported by a local MCA Clinical Trial Outreach Coordinator to maximize program results as needed.

Results: The team of researchers held a series of meetings to learn more about the project goals and to identify questions that would be incorporated into a final Phase I physician/provider survey instrument to be launched in the coming weeks. The survey will focus on the pre- and post-training on the mobile IT platform and the physician engagement or interest in the region for clinical trials promotion. Expected results are an increase in physician engagement and patient referral to the 367 regional trials (within 100 miles of Las Cruces, NM) that are "Recruiting, Not yet recruiting, Active not recruiting, and Enrolling by invitation" status [2].

Conclusion: The Clinical Trial Network (CTn) is a community-based approach to addressing the clinical trial disparities in the Borderplex region. The objective of this proposed pilot is to improve the region's healthcare providers and investigators' capacity to address patient needs and increase their trial awareness, engagement, and referral through the implementation of a centralized mobile IT platform and a healthcare ecosystem mediated by the MCA. Through the analysis of the effectiveness of this platform we hope to establish a working solution and platform for state and nation-wide adoption.

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Contributions of Social Determinants of Health to Postoperative Opioid Prescribing

Rebecca Nika Tsai
Mentor: Mark C. Bicket, MD, PhD

Context: In the US, one of the biggest determinants of health is your zip code.[1,2] Social and environmental exposures which affect health are known as "Social Determinants of Health" (SDH).[3] Patients with high social vulnerability are at greater risk of postoperative complications, as shown by researchers using the Centers for Disease Control and Prevention's (CDC) Social Vulnerability Index (SVI), which was designed to identify population-level vulnerability in national disasters.[4–7] Other state-level vulnerability indices exist, such as the Michigan Substance Use Vulnerability Index (MI-SUVI), which considers a population's vulnerability to substance use disorder.[8] The SVI has been used in prior studies to assess traditional surgical outcomes and patient vulnerability. There has yet to be an evaluation of SDH in the context of surgical care as it relates to opioid prescribing.
Objective: To determine whether there is an association between social determinants of health and opioid prescription status after surgery.
Methods: We conducted a retrospective study of 50,000 adults undergoing surgery from January 1, 2018 to May 15, 2022, identified using a Michigan statewide surgical clinical registry. Postoperative opioid prescription statuses were identified using a statewide surgical clinical registry. We will establish the association between post-operative prescription status and social determinants of health using the CDC SVI and the Michigan SUVI. We will analyze the data using a multilevel hierarchical model of the patients, prescribers, and geographic region. We plan to compare the value of the SVI vs. MI-SUVI as predictors of prescribing practices by calculating interclass correlations and median-odds ratio, adjusting for patient and clinical covariates. Establishing which social factors are associated with certain post-operative outcomes can better inform rational treatment based on patient vulnerability predictors.
Results: We will report on the descriptive analysis of the patient sample, comparing characteristics such as race, age, sex, comorbidities, procedure type, and patient status, for those who receive a prescription and those who do not receive a prescription. We will report on the association between SVI scores and prescription status, and the association between MI-SUVI scores and prescription status. We will calculate and compare the interclass correlation of each variable within the SVI and the MI-SUVI to assess the value of each variable within both indices. We will calculate the median-odds ratio of the SVI and MI-SUVI to assess to what degree each index is able to calculate the risk of opioid prescription status associated with residence in a high-risk county.
Conclusion: Social determinants of health are important factors that influence health outcomes, such as postoperative prescription status. We anticipate there will be a significant association between SDH and postoperative opioid prescription status. This will be the first comparison of SDH in the context of surgical care as it relates to opioid prescribing.

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The Spore in the Desert, Investigating the Distribution of *Coccidioides* in Southern New Mexico

Kyle Brice, Michael Schmidt, Einya Densmore, and Isaac Myszkowski
Mentor: Michael Woods, PhD

Context: *Coccidioides* spp. are fungal species endemic to dry, arid climates with high temperatures and low precipitation [1]. *C. immitis* and *C. posadasii* cause Valley Fever (VF) in humans. VF often presents asymptomatic or as a mild respiratory illness with the potential of severe pulmonary illness or rarely dissemination into extrapulmonary sites [2]. *C. posadasii* is documented to be present in many areas of Southwestern U.S. [3]. It also has been detected near small rodent burrows, which may play a role in the lifecycle. Little documented evidence of *C. posadasii* presence within New Mexico exists despite the suitable climate [4, 5].
Objective: The aim of our study is to determine presence of *C. posadasii* within the soil of New Mexico using RT-PCR. We plan to qualitatively demonstrate whether *C. posadasii* DNA is present in New Mexico using TaqMan probe-based techniques for PCR. We will elute DNA from soil samples near woodrat burrows suspected to contain the fungal DNA. Identifying the causative agent of VF in New Mexico is a crucial step to take in improving patient outcomes in NM.

Methods: To begin the groundwork for identifying *C. posadasii*, we received an avirulent strand ($\Delta chs5$) of the fungus from NIH and subsequently cultured it in 1xGYE and 2xGYE liquid media [6]. After successful growth, the strains were used to verify both CocciDX and CocciENV primer assays using RT-PCR.

Soil collection and Extraction

Soil samples were taken west of the research facility and just west at the foot of the Organ Mountains. We identified locations that showed animal activity where burrows were intact with several layers of sticks and wood rat feces and collected several samples of 1g soil from the burrows. Soil extraction was performed, and the resulting product was run through RT-PCR using duplicate wells for each sample using the Cocci assays.

Results:

Determining Limit of Detection (LOD) for CocciDx and CocciENV PCR assays

Both the CFX Opus and CFX96 machines yielded similar results with no significant difference in detection sensitivity. The CocciENV assay detected presence of *Coccidioides* DNA at a statistically significantly earlier cycle by an average of 0.92 Cq for samples both assays were able to detect (p-value = 2.11E-09). We found our LOD for both assays to be below 1ng of DNA and we estimate that we can reliably detect as few as 10 genomes.

Testing DNA Extraction from Soil

We detected Cocci organisms in spiked soil samples using the preferred Omega BioTek E.Z.N.A. soil DNA kit to elute DNA [7]. Using both assays, we detected as few as 104 genome copies of purified Cocci DNA per gram of spiked soil. Assuming 70% DNA recovery efficiency from soil in 50 uL elution, we estimate we can detect $\sim$7,000 genomes/gram of soil ($\sim$140 genomes per reaction); 10-fold lower sensitivity than purified DNA.

Sampling for *Coccidioides* spp. in the Las Cruces Region

Of the 115 samples taken from 16 burrows, we did not consistently detect the presence of Cocci in any soil samples. We detected low levels of *Cocci* DNA in one soil sample but follow-up sampling and testing of the same burrow yielded negative results.

Conclusion: While still ongoing, preliminary results indicate that use of CocciENV and CocciDX assays to detect *C. posadassi* within soil is a viable option. Both assays were able to reliably detect *Coccidioides* down to as few as 104 copies per gram of positively spiked soil.

Notably, the CocciENV assay was able to detect our positive controls with significantly fewer cycles than the DX assay. This supports the findings of Bowers, et al. in that the ENV assay is more robust than the DX assay. [8]

The sampling methods in this study primarily focused on acquiring samples from large rodent burrows. A total of 115 samples were taken, with only one reading positive. Retesting of the "positive" burrow site resulted in no additional detection. Additional testing will be required to further verify applicability of the method in the field.

Future plans for research will include targeted sampling via surveying people infected with VF in the Las Cruces area to evaluate possible sites of infection. With this information, we can conduct a similar collection method/extraction of DNA previously performed along while refining our technique to potentially improve our results.

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Healthcare Provider Perceptions and Behaviors May Influence HPV Vaccine Uptake in the El Paso/Doña Ana County Community

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Context: Human papillomavirus (HPV) is the most commonly sexually transmitted infection in the United States and is associated with the development of numerous types of cancer. Despite the ability of the HPV vaccine to limit infection and prevent cancer (1), only 62% of 13-17 year olds were up-to-date on vaccination nationally in 2021 (3). Texas had lower and falling rates of vaccine uptake (4), but El Paso County was remarkably higher at 66% (5), highlighting the value of studying this region.

Objective: To assess knowledge, perceptions and attitudes about HPV and the HPV vaccine among healthcare providers in El Paso and Doña Ana Counties. The goal of this work was to identify provider behaviors that affect vaccine uptake, since it has been shown that strong provider recommendation is a critical factor in patient vaccine acceptability (2). Strengthening recommendations would ultimately increase cancer prevention in the often-marginalized communities served by these providers.

Methods: Current (in practice) or emerging (in training) healthcare providers currently living and/or working in El Paso County, Texas or Doña Ana County, New Mexico were enrolled. Our primary focus was on individuals in, or pursuing, the fields of medicine, pharmacy, and nursing. Participants provided their informed consent and completed an online survey that included demographic questions along with questions about HPV, HPV vaccine uptake and cancer screening. Additional questions addressed personal experiences associated with HPV, vaccines, and cancer. Assessments of governmental and organizational trust, religiosity, political affiliations, and family versus individual beliefs were also represented in survey questions. Qualitative survey responses were evaluated and converted, where appropriate, to numeric scores for statistical analysis by t-test with $p \leq 0.05$ considered significant.

Results: A total of 93 complete survey responses were collected from providers within the borderplex region (age 29 ± 9 years). The majority of providers ($\sim$70%) surveyed self-identified as Hispanic. Perceptions of HPV vaccine efficacy were high among the participants, with no significant differences seen between female and male ($p=0.384$) or Hispanic and non-Hispanic ($p=0.304$) providers. Additionally, perceptions of vaccine efficacy were unaffected by political affiliation ($p=0.591$) or family structure ($p=0.131$). Similar findings were seen regarding questions of vaccine hesitancy, with no differences observed between Hispanic and non-Hispanic providers ($p=0.315$); male providers did not demonstrate higher levels of hesitancy compared to female providers, but there was a data trend in that direction ($p=0.076$). Likewise, no statistically significant differences were seen in vaccine hesitancy based on the personal characteristics of political affiliation ($p=0.220$), family structure ($p=0.817$), or religiosity ($p=0.163$). Finally, there was no significant relationship between exposure to HPV phenotypic traits and vaccine hesitancy in healthcare providers in the region ($p=0.314$). Provider opinions on vaccine efficacy did not differ by zip code within El Paso County. However, statistically significant differences were observed in vaccine hesitancy when comparing the Festival/Coronado region and the Cielo Vista/East Side ($p=0.024$), Lower Valley ($p=0.005$), and Upper Valley/Coronado ($p=0.052$) neighborhoods.

Conclusion: Prior review of the data from this study showed that current and emerging healthcare

providers in the Paso del Norte region have high levels of HPV and vaccine knowledge, but limited vaccine uptake among eligible individuals. Moreover, there was a significant difference in the vaccination rates of men compared to women in this study. Here, we more fully evaluated HPV- and vaccine-related attitudes and behaviors among providers. Not surprisingly, we conclude that perceived efficacy of the HPV vaccine is high and HPV vaccine hesitancy is low among healthcare providers in El Paso County and Doña Ana County, independent of their ethnic background, sex, political affiliation, family structure, religiosity, or exposure to HPV phenotypic traits. This may be associated with the observed higher rates of HPV vaccine uptake by patients in the borderplex region. There does appear to be variation in provider vaccine hesitancy, however, based on the specific zip code in which they practice, and there was an indication that male providers may differ from female providers in their vaccine hesitancy. Therefore, we have identified some areas for possible intervention in order to further increase HPV vaccination rates and cancer prevention in this region.

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Development of a Loop-Mediated Isothermal Amplification Assay for the Detection of Human Papillomaviruses 16 and 18

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Mentor: Debra Bramblett, PhD

Context: HPV types 16 and 18 are responsible for nearly 70% of global cervical cancer cases. HPV 16 and 18 are prevalent in 55.2% and 14.2% of global cervical cancer cases, respectively (HPV Information Center, 2023). Given this association between HPV and cervical cancer, it would be imperative to develop early-diagnostics for HPV infections. Current diagnostic measures involve PCR, which is expensive, complex, and time consuming (Marfatia, Dixit, & Bhavasar, 2011). In contrast, LAMP promises to be easier, cheaper, and takes only thirty minutes (Inaba, Higashimoto, Toyama, Horiguchi, Hibino, Iwata, Imaizumi, & Doi, 2021).
Objective: This study aimed to develop a Loop-Mediated Isothermal Amplification (LAMP) Assay, as well as a Lateral Flow Assay (LFA) for the use in the detection of Human Papillomaviruses (HPV)-16 and -18, in a clinical setting.
Methods: To develop the LAMP assay, custom primers (F3, B3, FIP, BIP, LF, LB) were designed with Primer Explorer. The NIH's GenBank was used to identify the sequence of HPV 16's and 18's E6/E7 region. Conserved regions of E6/E7 were identified using ClustalOmega (Sievers, Wilm, Dineen, Gibson, Karplus, Li, Lopez, McWilliam, Remmert, Söding, Thompson, & Higgins, 2011). The most conserved sequence for each virus (HPV-16 and HPV-18) were uploaded into Primer Explorer to identify the primer sequences that provided the lowest free energy (DG) for the LAMP reaction. Once the primer sequences were designed, they were aligned in another ClustalOmega alignment in SnapGene to screen the homology of the different HPV types and primer to primer homology. The primers were ordered from Integrated DNA Technology (IDT). For LFA detection of the LAMP products, it was necessary to either biotinylate or DIG label the FIP primers and FAM conjugate the BIP primers. The LAMP reaction mixture consisted of nuclease free distilled water (Thermofisher, Cat 10977015), the primer mix, the HPV plasmid DNA (American Type Culture Collection- ATCC; 45113D or 45152D), and Warm-Start Master Mix (New England Biolabs E1700S). The Warm-Start Master Mix consisted of phenol red, the *Bst2* enzyme, deoxyribonucleotides, and other appropriate reagents for the LAMP reaction. The *Bst2* enzyme allows the LAMP reaction to take place at the single temperature of 65°C. We used the MJ Research PTC-200 to ensure the accurate temperature and to conduct temperature gradients. The LFA used the LAMP product, in combination with Milenia Biotec's Hybridetect 2T Lateral Flow detection strips and HybriDetect Assay buffer. The LFA was used to detect the HPV-16 and HPV-18 in a control sample that contained the viral genomic sequences (Milenia Biotec, 2021).
Results: Each LAMP assay consisted of 6 reactions. For each set of reactions, we included a No Template Control (NTC) that contained the Primer Mix without any DNA. There was also a positive control, which used *M. genitalium* DNA and primers, at first, and then subsequently HPV 18 after verification. Reaction conditions were varied in the remaining 4 reactions in the assay. Different concentrations of HPV 16 or HPV 18 plasmid DNA were tested, and the lowest detectable copy number was 1.64558×10^5. The primers were tested for specificity against the other HPV type to confirm the virus type specificity of the primers. Both primers were able to correctly identify their HPV type without amplification of the other type. The LAMP reaction conditions were verified by running multiple reactions on a temperature gradient, with different amounts of primers, and

different concentrations of HPV plasmid DNA. The ideal conditions were determined to be 65°C, with 6 µL of primers and a HPV concentration of 1:1000. These conditions yielded the strongest positive LAMP. A positive reaction was considered to be a color change from red. A strong positive was considered to be yellow, while a weak positive was orange or salmon. Loop primers (LF and LB) are considered necessary for optimal LAMP amplification, however while designing the primers, the full set of loop primers could not be generated. Therefore, the primers were only designed with half of the necessary loop primers. The LFA results showed a visible line indicating a positive, and the absence indicating a negative. The duplex nature of the 2T detection strips allowed LAMP products to be combined to display the results for both HPV types on one strip.

Conclusion: It can be said that this study was successful, as its objective was accomplished. This investigation was able to develop a LAMP Assay and Lateral Flow Assay for HPV types 16 and 18. The assays, with their primers, were able to correctly identify their respective virus type, indicating sensitivity. They were also able to correctly not identify the wrong virus type when they were tested with the opposite HPV type, indicating specificity. Although the LAMP reaction did use a thermocycler, it only needed to be set at one temperature throughout its run to yield its results. This demonstrated that the reaction does not need a thermocycler and therefore could be performed with cheaper and simpler equipment. The reactions were able to provide results within 30 minutes, demonstrating the speed of the assays and their advantages in a diagnostic setting. This investigation can be improved by expanding the scope of the assays to include other high risk HPV types, as well as improving the primer design to use the full set of loop primers. Further explorations that can be done with the study, would be to use the assay to test for the presence of HPV genetic material in-situ, such as in HeLa cells and primary cervical cells. The cervical cells could be obtained from a laboratory diagnostic provider, such as Tricore, and tested with the assay to assess the validity, sensitivity, specificity, positive predictive value, and negative predictive value of the assay.

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The Role of Medication, Mental Illness, and Social Isolation on the Development of the Fetus in the Context of the COVID-19 Pandemic

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Context: As we enter the COVID-19 post-pandemic period, there is a lot of uncertainty regarding the varied effects of medications, mental illness and social isolation on children born during the pandemic. It is imperative to explore these effects as it can have downstream implications on physical and mental health of children and adults alike. There are many maternal medications that cross the placenta and are known to have detrimental effects on the fetus. Some of them cause serious malformations and these include: Vitamin A, ACE inhibitors, Warfarin and Lithium. Chloramphenicol is known to cause Gray Baby Syndrome characterized by abdominal distension and hemodynamic collapse [1]. Other drugs like opiates are known to cause neonatal withdrawal syndrome. Medications such as Selective Serotonin Reuptake Inhibitors (SSRIs) can also cause neonatal withdrawal syndrome [2]. In addition, there is a higher frequency of admission to a special care nursery for infants exposed to SSRIs during the third trimester [3]. It is unclear whether medications such as SSRIs have long-term effects on children with fetal exposure. These effects may include but are not limited to: internalizing and externalizing behaviors, change in IQ, cognitive changes, anxiety symptoms, and childhood depression.

Anxiolytics (Benzodiazepines), are commonly used medications in depressed and anxious populations. Although not contraindicated in pregnancy, maternal use of anxiolytics have resulted in postnatal changes. Benzodiazepines have shown to cause sedation, withdrawal symptoms, and floppy baby syndrome, all detrimental effects to the developing infant [4]. Additionally, the withdrawal syndrome seen with maternal benzodiazepine use is significantly greater than that seen with maternal SSRI use. It is important to consider that many mothers often take benzodiazepines and SSRIs as a combination therapy, thus increasing the risk of adverse effects in the developing fetus/child.

During the height of the COVID-19 pandemic, social isolation played a large role in the increased incidence of depression and anxiety, and therefore, subsequent use of antidepressant and anxiolytic drugs increased linearly [5]. Moreover, previous research established that social isolation is known to have detrimental effects on mother and child [6].

Methods: We conducted a literature review. *NCBI* and *PubMed* were searched using the following words: 'SSRI,' 'fetal development,' 'anxiolytics,' 'antidepressants,' 'congenital malformations,' 'contraindicated,' 'pregnancy,' 'fetus,' 'substance use,' 'social isolation,' and 'maternal depression.' *Elicit: The AI Research Assistant* was prompted using the following phrases: 'the effects of medication during pregnancy and its effects on fetus,' 'antidepressant fetal withdrawal syndrome,'

'maternal medications and their effect on fetal development,' 'maternal use of SSRIs on fetal development.' The references resulting from these searches were reviewed and analyzed for their relevance.

Medical Hypothesis: Fetuses exposed to medications such as SSRIs and benzodiazepines, maternal mental illness, along with social isolation due to the COVID-19 pandemic will demonstrate long-term multiplicative behavioral changes later in life. Evidence has shown that maternal use of SSRIs and benzodiazepines, especially during the second and third trimesters of pregnancy, can result in the fetus developing anxiety symptoms, childhood depression, and internalizing and externalizing behaviors [7]. Additionally, social isolation due to the COVID-19 pandemic increases chances of depression, anxiety, sadness, and guilt.

Support for Hypothesis:

SSRI effects on brain development

In the mouse, SSRI effects include: increase in volume of amygdala and insula, and increased connectivity between these regions [8]. In the human, SSRI effects include: thick left lateral occipital cortex, larger surface area of the left superior parietal cortex [9], changes in the microstructure of the right amygdala [10], and altered neural plasticity in the hippocampus due to an increase in BDNF expression [11].

Known effects of SSRIs on different regions of the brain

SSRIs are known to help improve an individual's mood, which is linked to the medication's effects on the dorsal raphe nuclei [12]. Moreover, the effects of trans-placental SSRI's on fetal brain development are unclear.

Postnatal maternal Benzodiazepine effects

Third trimester benzodiazepines are known to have the following postnatal effects on the neonate: hypertonia, hyperreflexia, excessive crying, tremors, bradycardia, restlessness, irritability, seizures, abnormal sleep patterns, cyanosis, "Floppy Baby syndrome" (characterized by: hypothermia, muscular hypertonia, low apgar scores) [13]. These effects may take a longer amount of time to subside, depending on the amount and length of time of exposure in utero. It is also believed that Anxiolytics (Benzodiazepines) have a greater withdrawal symptom than that resulting from SSRIs [3].

Social isolation effect on neonates

Being 3 years post-COVID-19 pandemic, we are beginning to see the effects of social isolation on populations. In particular, these effects are likely exacerbated in mothers and their infants born during the pandemic. These changes are manifested by the increased use of antidepressants in the mothers [5]. Historically, there has been a significant social impact of institutionalization/social isolation on children in a post-Soviet country [15]. Similarly, the social isolation experienced by migrant mothers has been shown to negatively impact their children [6]. These negative effects will likely manifest in children born during the COVID-19 pandemic.

Conclusion: The effects of maternal medications on fetuses, in conjunction with mental illness and social isolation, have not yet been explored post-pandemic. Additional factors such as increased rates of maternal mental illness and social isolation have likely potentiated the neurobehavioral effects of these medications on children born during the pandemic. To evaluate the aforementioned effects, we propose increased surveillance for behavioral changes in educational settings. This would include increased teacher/staff training to recognize these changes. The children identified as "at risk" for negative outcomes should be referred to behavioral counseling and other early-childhood interventions in order to prevent future problems as they grow

older. We encourage pediatricians and other early childhood caretakers to complete behavioral assessments prior to school age. We recommend additional research pertaining to the long term behavioral effects of maternal SSRIs on these cohorts. Controls may be difficult to select due to the global impact of COVID-19; however, controls could be identified using siblings born prior to the pandemic. It is critical to understand these implications in order to prevent further detrimental effects on the children born during the pandemic. This study was conducted with the intention of disseminating these ideas to help the individuals caring for children recognize potentially affected children. Children may then benefit from interventions intended to mitigate the adverse effects associated with the COVID-19 pandemic.

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Detecting SARS-CoV-2 in Bats of New Mexico using Immunohistochemistry on Formalin-Fixed, Paraffin-Embedded Tissues

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Mentor: Thomas Eiting, PhD

Context: The emergence of severe acute respiratory syndrome coronavirus (SARS-CoV-2) and its zoonotic origin have raised critical questions regarding the potential role of local bat populations as reservoirs or intermediates for the transmission of this or related coronaviruses to humans. This research project aims to investigate the presence of Coronavirus antigens in native bat species inhabiting the Southwest desert.
Objective: This study has two primary aims: (1) to detect SARS-CoV-2 antigens in tissues of local bat populations via histological methods and (2) to perform a molecular screen of coronaviruses in these bats. The initial phase of this project was dedicated to developing protocols to test the above aims.
Methods: Five bat species were evaluated in this study: *Artibeus jamaicensis*, *Myotis velifer*, *Antrozous pallidus*, *Tadarida brasiliensis*, and *Eptesicus fuscus*. All species were local, wild-caught bats with the exception of *Artibeus jamaicensis*, which is from a colony established at NMSU.
Tissue collection: Tissue was sourced from bats collected by the lab of Dr. Teri Orr at NMSU, who is studying these animals as part of an NSF- and NIH-funded project studying SARS-CoV2 in local bat populations. Tissue was fixed in the lab of Dr. Orr, and then samples were taken of lung, kidney, nasal septum, nasal epithelium and uterus.
Histology: Tissue was stored in formalin or 70% ethanol and then dehydrated via subsequent wash steps from 70% to 100% ethanol. Samples were then washed with Histoclear/Hemo-De, followed by embedding in paraffin. Paraffin blocks of tissue samples were sampled on a rotary microtome at 4 μm thickness. Sections were mounted on slides and then run through a hydration series from 100% to 70% ethanol and washed in 0.5% hydrogen peroxide in methanol. The slides were placed in BOND epitope retrieval solution and then incubated in 5% normal goat serum (NGS) to reduce background signal. The two primary antibodies tested targeted non-specific coronavirus nucleocapsid and spike protein. Slides were stained with hematoxylin and DAB to view cellular structures and any coronavirus proteins, respectively. Slides were coverslipped with DPX mounting medium and observed via light microscopy.
PCR and RNA sequencing: The purpose of this project phase was to identify Reverse RNA polymerase, indicating Coronavirus presence in the tissue. Tissue was disrupted using a homogenizer, and RNA was extracted with Qiagen Quick-Start Protocol RNeasy® Plus Mini Kit. The RNA extract was used for cDNA synthesis, followed by PCR using Roche PCR Master kit with specific cycling conditions. This process was repeated twice with different primers to isolate the Reverse RNA polymerase sequence. The expected result after the second run was around 400 bp. The results, along with positive and negative controls, were analyzed using Gel electrophoresis with 1.2% Agarose mixed with TAE.
Results: To determine whether coronaviruses could be detected in local bat tissues via histological methods, antibodies against nucleocapsid and spike protein were evaluated. The immunohistochemistry protocol was tested using tissue from one individual per bat species and on human placenta samples known to be positive for SARS-CoV2. The latter was used as positive controls. To maximize the possibility of seeing coronavirus in our bat samples, lung, kidney and nasal ep-

ithelial tissue were used. Putative positive staining was seen in both placenta and nasal epithelial samples with the nucleocapsid antibody. The nucleocapsid staining pattern observed in our tissues was similar to that seen in the literature. We were unable to detect coronavirus signal in both test and positive control samples using the spike protein antibody. Because no signal was detected in the controls, it was decided that this antibody would not be effective for our purposes. The two samples that were run on PCR came up negative. However, these two samples were not from the species that we had previously found to be positive using immunostaining. It is also feasible that a part of our process failed to produce the correct product from RNA to cDNA to our final DNA product. This is a part of the project that we desire to refine and improve going forward.
Conclusion: We were able to detect coronavirus in human placental tissue used as our positive control and in nasal epithelial tissue from the Jamaican fruit bat (*Artibeus jamaicensis*) using a nucleocapsid antibody. Now that we are more confident about our histology protocol, more tissue samples are needed from multiple bats per species to do a proper screen for coronaviruses in the local population.
While we did not obtain any positive results in the genetic testing, we are confident that we will be able to do so in the future by primarily focusing on tissues that we know to be positive from immunostaining. Once these are run, our next goal is to further our understanding of the variant the bat is carrying by sending for it to be sequenced and seeing if it is a novel or previously discovered variant of the Coronavirus.

The Microbiology and Treatment in a Rare Case of Bedbug Induced Normocytic Anemia

Atish Anit Kumar, Shalvi Prasad, Ariel Hurwitz
Mentors: Marc Benson, PhD and Sepehr Khashaei, MD

Context: Parasitic anemia is a rare cause of chronic or acute blood loss in modern countries[1]. The most common species of bedbugs are Cimex lectularius which average 5-6 mm in length as an adult and are hematophagous insects[2]. Case reports have shown that bedbug infested patients have lower hemoglobin, hematocrit, RBC counts, mean corpuscular volume, mean corpuscular hemoglobin concentrations, and higher RDW when compared to non-infested individuals[3,4]. Additionally, up to 30% of individuals with bedbug exposure are asymptomatic[5]. There is an increased chance of bed bug infestation in patients with positive blood cultures growing coagulase-negative Staphylococcus, pneumonia, cellulitis, needed an infectious disease consult, needed a chest radiograph, and had a high percentage of eosinophils in blood.[6]

Objective:

1. Describe a case report highlighting the importance of social determinants of health when treating a patient for normocytic anemia caused by bedbugs.

2. Analyze the medical course and treatment to deduce the root cause of anemia in a patient.

3. Demonstrate the importance of an interdisciplinary approach to patient care in treatment of a bedbug infestation leading to anemia in a patient.

Methods:

History of Present Illness: A 78-year-old male with PMHx of chronic asthma, HTN, and BPH presented to the ED for an acute onset of dizziness, SOB, and fatigue. The patient was brought in by ambulance workers who reported his home to be infested with cockroaches and bedbugs.

Initial Examination: Vital signs: BP 135/76, P 74, RR 18 on Room Air.

Pertinent physical exam findings: pale skin, no appreciable active lesions associated with bed bug bites.

Hospital Course: Upon intake, the patient was found to have a Hgb level of 7.1 (MCV 84) and lactic acid level of 2.4. Following decontamination, the patient was repleted with 1 unit of pRBC, which improved his hemoglobin to 8.4 and resolved his symptoms. The patient's lactic acidosis resolved with oral rehydration. Chart review revealed two previous admissions for acute anemia with suspicion of bedbug related parasitic anemia versus acute GI bleed. The patient's first admission labs showed Hgb/HCT of 6.8/21 and normal MCV with improvement following transfusion and subsequent oral iron therapy. During a previous admission, stool guaiac, EGD, and colonoscopy found no evidence of bleeding. As an outpatient, capsule endoscopy found peptic duodenitis, clustered lymphangiectasias in the proximal small intestine, and a small erosion in the proximal small bowel. All findings were not concerning for an active GI bleed.

Results: The patient was vocal to social work about his living conditions and desire to leave his location, but his income was limited to social security checks. Upon this admission, the patient requested to have his landlord reported to adult protective services (APS). APS discussed options with the patient's landlord. Upon hearing this, the patient was concerned about retaliation from

his landlord. The patient was medically stabilized and discharged with iron therapy and scheduled follow up.

Conclusion: Bed bug infestation is a concern for low-income patients. Although an uncommon presentation for anemia, it is important to consider social context when patients repeatedly present for anemic events. After a diagnosis of parasitic anemia is established, a careful search for a causative source is important for the patient's future recovery from anemic events. Bed bug management is notoriously difficult as bugs are resistant to chemicals. Special services, which can be costly, are often required to rid homes of bed bugs.

During a blood meal, bed bugs secrete proteins into the host that play a role in food acquisition and detection. These proteins include nitrophorin (a vasodilator that increases access to blood), apyrase (an anti-clotting factor, and anesthetic (prevents host pain during blood meal). The host response to the bite varies, partly based on immunological response. About 30bites and may not know they have been bitten. This is especially true in the elderly, who may not be able to see bites or may take medications that prevent a response. Patients that produce bed bug wheals, or papular urticaria, produce IgG antibodies.

In acutely anemic patients with appropriate risk factors, it is important to assess living conditions and inspect belongings to deduce the cause of anemia. Standard treatment for parasitic anemia due to bed bugs is transfusion therapy. It is imperative to take a multidisciplinary approach to involve social work and pest management services to find a home with no bedbugs and help exterminate bedbugs, respectively. In addition to medical management of iron deficiency anemia caused by bedbugs.

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Abstracts - Session 3

Screening Publicly Available CT Datasets of the Head for Potential Use in Studying Normal and Pathological Issues Related to Nasal Airflow

Kailey Simonson and Ruchy Aggarwal
Mentor: Thomas Eiting, PhD

Context: The nasal cavity is the interface between the lower respiratory tract and the atmosphere. It is responsible for delivering air in a warm, humidified form to the lower respiratory system and olfactory mucosa utilizing evolved intricate anatomical structures. Little is known about specific morphologies that contribute to effective airflow as well as those where impeded airflow leads to undesirable outcomes. In this project, publicly available CT datasets were utilized to examine nasal anatomy and create a diverse set of 3D airway models to study normal and pathological airflow. This project will help us develop predictive models of how nasal airway anatomy variation contributes to clinical disorders.
Objective: The purpose of this study was two-fold. First, we wanted to develop optimized strategies for evaluating publicly available CT datasets for use in simulated studies of airflow. Second, we sought to generate 3D models of the nasal cavity from these CT datasets and perform Computation Fluid Dynamics (CFD) modeling of airflow in the generated models. Models can be used to study diversity in airflow patterns and rates, microparticle and odorant deposition and the contributions of anatomical variations to difference in airflow and pathologies.
Methods: 490 CT scans were downloaded from the CQ500 repository dataset and evaluated for effectiveness in building digital models of the nasal airway. Scans were digitally dissected and analyzed in 3D Slicer to determine eligibility for model creation and simulation. Eligible scans were further edited in 3D Slicer. All ethmoid air cells, sinuses and recesses were removed as it was determined these areas do not contribute to the airflow we want to study. These reconstructed models made in 3D Slicer were further refined using the program MeshMixer. Once in MeshMixer, artificial details and artifacts that were created as a result of editing in 3D Slicer were removed. Once editing was completed in MeshMixer, these STL files were imported back into 3D Slicer to be overlayed with the original STL file created directly from the CT scan to verify anatomical accuracy. Any inaccuracies were removed with further editing in MeshMixer. Models were then imported into Meshlab, where they were converted into “solid models” for CFD analysis. All CFD was performed in OpenFOAM, and final results were visualized using ParaView.
Results: Five models have been reconstructed utilizing modeling requirements, 3D Slicer, and MeshMixer. These programs were compatible with the anatomical organization that comes with bulk editing and refinement. To be a strong candidate for modeling, the CT scan had to include at least 230 slices, show all anatomy relevant to the study including turbinates, ethmoid air cells, the cribriform plate and olfactory region, nasal vestibules, and the nasopharynx, and display adequate detail. All scans were evaluated in 3D Slicer, where preliminary models were created based on air thresholds and determined for their fit for use. Of the five final models, four were deemed anatomically normal and all relevant anatomy was intact. One of the five models displayed a deviated septum. The four “normal variants” can be used to predict normal patterns of airflow using Computational Fluid Dynamics (CFD). The deviated septum nasal model will serve as a pathological example which will be run through CFD in the future. CFD is currently being run for one of

our “non-pathological” models. So far, we are showing airflow patterns through the left and right airways were very similar. The pathological case involving a deviated septum is being refined and will be run which will allow us to compare both cases.
Conclusion: In conclusion, it was determined that CT scans from the publicly available CQ500 repository dataset are effective in creating digital models of the nasal airway to be used for CFD. Computational modeling was shown to be an insightful tool in understanding how nasal morphology contributed to the diversity in airflow patterns and rates, microparticle and odorant deposition. We were able to gather both pathological and non-pathological models. Thus far 5 CT scans out of 490 specimens were eligible for modeling; however, due to time constraints of the study, these were the only scans that were utilized. Four of these models were “normal variants” while the scan with a deviated septum was a “pathological variant.” One of the non-pathological models is currently being run in the OpenFOAM CFD program and shows promising results with similar airflow patterns through both the left and right airways. All other models will also be analyzed in this CFD program and more rounds of CFD will be run to compare airflow dynamics for normal and pathological variants.

Quantification of Budesonide Retained in the Sinonasal Cavity After High-volume Saline Irrigation in Post-operative Chronic Rhinosinusitis and Healthy Subjects

Paige Shipman
Mentors: Abigail Pulsipher, PhD and Kristine A. Smith, MD

Context: The off-label use of budesonide in high-volume saline irrigations (HVSI) is recommended for the treatment of post-operative chronic rhinosinusitis (CRS)[1]. Safety studies of budesonide HVSI have been limited by short duration of follow-up assessments, small sample sizes, and single endpoint analysis for evaluating systemic absorption[2−6]. In these studies, the delivered dose to the sinonasal cavity was estimated using fluid residuals without budesonide quantification.
Objective: To determine the amount of budesonide retained in post-operative patients with CRS and in healthy volunteers after HVSI of the sinonasal cavity.
Methods: A prospective, observational cohort study was conducted with adult patients diagnosed with guideline-based CRS who had undergone endoscopic sinus surgery (ESS) and had an active budesonide HVSI prescription. A control cohort of healthy volunteers, exhibiting no sinonasal symptoms and no history of CRS diagnosis, was also included. Healthy volunteers and patients with CRS irrigated with 240 mL of normal saline containing 0.5 mg of budesonide over a glass funnel, and the total effluent was collected. The amount of budesonide in the total effluent and remaining in the irrigation bottle was quantified using high-performance liquid chromatography (HPLC). To determine if patient characteristics were associated with the retained dose of budesonide Spearman correlations were used, and two-tailed T-test were used to compare cohorts. A value of $p<0.05$ was used to determine significance.
Results: A total of 29 participants (CRS, n=24; controls, n=5) met inclusion criteria. The average retained dose of budesonide across the CRS and healthy cohort was respectively 0.221 ± 0.087 mg and 0.121 ± 0.019 mg, accounting for 42% and 24% of the administered dose. The measured

amount of retained budesonide in controls and CRS was significant (p = 0.0002). The number of months post-ESS had a significant impact on the measured retained dose in patients with CRS. Those irrigating within 3 months (early) post-ESS retained 0.29±0.07 mg (56%) and those irrigating after 3 months (late) post-ESS retained 0.17±0.06 mg (32%) (p=0.0004). The amount of retained budesonide in the control cohort was significantly lower compared to in the early cohort (p=0.0006) but not significantly different compared to in the late cohort (p=0.206).
Conclusion: The retained dose of budesonide HVSI in patients with CRS and healthy volunteers was found to be significantly higher than previously estimated, and decreased over time post-ESS. The amount of retained budesonide after HVSI in the control group was significantly lower than in the early CRS cohort, but was not significantly different compared to in the late CRS cohort. This evidence suggests that budesonide absorption varies depending on the state of mucosal inflammation and is higher than previously estimated, supporting the need for further safety evaluations and clinical studies to measure the pharmacokinetic and pharmacodynamic properties of budesonide HVSI.

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Ischemic Fasciitis: A Rare Pseudosarcomatous Dermatological Diagnosis

Atish Anit Kumar, Nandini Patel, and Christian Crawford
Mentors: Gabor Szalai PhD, Shalvi Prasad DPM PGYII, David Hyer DPM, and Sarah Mele DPM

Context: This case report presents a 64 year old Male with ischemic fasciitis to the left forefoot. Ischemic fasciitis, also known as atypical decubital fibroplasia (ADF) is a rare, benign soft tissue tumor that occurs in elderly, with inconsistent association with debilitated or immobilized patients (2). This condition is a pseudosarcomatous fibroblastic lesion typically found over bony protuberances in the axial skeleton and limb girdle (2). Management is excision (9). Local recurrence rates are higher when compared to other reactive pseudosarcomatous, however they pathologically remain ischemic fasciitis (9). It is important to keep in mind that there is a documented case of recurrence that led to Myxofibrosarcoma (4). This case study highlights a rare presentation of ischemic fasciitis in the foot of an active patient.

Objective:

1. At the completion of this session, participants will know when to include ischemic fasciitis as a differential diagnosis in non-healing wounds or soft tissue masses, and how to confirm a diagnosis of ischemic fasciitis.

2. Based off of this research, one should be able to create a treatment plan for ischemic fasciitis.

3. Information from this case study can help one to identify the histopathological characteristics of ischemic fasciitis.

Methods: A Pubmed search was carried out using the keywords “Ischemic Fasciitis.” Articles were then reviewed for relevant information in relation to our case. 11 articles were found using this method including 8 case reports, 1 case series of 44 patients, and 2 literature reviews. One case of Ischemic fasciitis of the lower extremity was noted, present at an above the knee amputation stump (7). Results from this literature was used in order to determine the treatment plan for our case study.

Results: We present a case of a 64 year old Male undergoing treatment by Podiatry for bilateral plantar foot diabetic ulcers that later developed a soft tissue mass at an ulceration site. The patient was being treated for ulcers to the right lateral fifth metatarsal head and left hallux stump. Prior to the diagnosis of soft tissue mass, the patient presented to the Emergency Department with increased swelling to the right lateral fifth metatarsal ulceration and was concerned that he had an abscess developing at that site. Podiatry was consulted and after arriving at the Emergency Department, no purulence was expressed from the suspected abscess site and he was followed up in Podiatry clinic 3 days later. An MRI was ordered at this time to rule out osteomyelitis, but imaging revealed a firm soft tissue mass at the location of the ulcer, along the lateral aspect of the right fifth metatarsophalangeal joint. The patient had mass removed, and pathology was consistent with Ischemic Fasciitis. He remains mass free at 10 months follow up.

Literature Review: Clinical Presentation and Etiology: Ischemic fasciitis typically affects adults, and there seems to be no significant gender predilection. The reported cases present with various anatomical locations, including the buttock, extremities, and pressure ulcer sites, indicating that

this lesion can occur in different contexts. It has been described in both debilitated individuals and those without significant comorbidities, challenging the previously proposed association with immobility or debilitation. Several case reports have highlighted interesting associations and predisposing factors. For instance, Gavin et al. (2019) reported a case of ischemic fasciitis in a debilitated older man, while Ayoubi and Baldwin (2019) presented a case associated with lower extremity prosthesis use. Moreover, Sakamoto et al. (2018) described a case in a patient with beta-propeller protein-associated neurodegeneration (BPAN). These cases suggest that ischemic fasciitis may occur in the setting of local trauma, mechanical stress, or underlying genetic conditions.

Histopathological Features and Differential Diagnosis: Histopathologically, ischemic fasciitis exhibits distinctive features, including fasciitis-like spindle cell proliferation, ischemic necrosis, and myxoid stromal changes. The lesion can be mistaken for sarcomas due to its rapid growth and cellular atypia. However, differentiating ischemic fasciitis from true sarcomas is crucial to avoid overtreatment. Rosenberg (2008) reviewed the pseudosarcomas of soft tissue and emphasized the importance of accurate diagnosis to prevent unnecessary interventions. The presence of ischemic necrosis, absence of mitotic activity, and lack of genetic abnormalities associated with sarcomas, as demonstrated by Sachak et al. (2018), help differentiate ischemic fasciitis from true malignant tumors.

Treatment and Outcome: The optimal management approach for ischemic fasciitis remains unclear due to its rarity and varied clinical presentations. In most cases, surgical excision is the treatment of choice. Lopez and Rayhrer (2021) reported a case where ischemic fasciitis converted into myxofibrosarcoma, highlighting the importance of complete excision and close follow-up. Recchi et al. (2022) presented a unique case where ischemic fasciitis appeared on a pressure ulcer after negative pressure wound therapy. This case highlights the need for careful monitoring of wound healing interventions, as ischemic fasciitis can arise as a complication.

Conclusion: Ischemic fasciitis is a rare and challenging lesion that can mimic sarcomas clinically and histopathologically. Through an analysis of case reports, this literature review provides insights into the diverse clinical presentations, associations, and management considerations for ischemic fasciitis. Further research is needed to elucidate the underlying etiology and optimal treatment strategies for this intriguing pseudosarcomatous entity, especially in the lower extremity. Although Ischemic fasciitis is more commonly found in axial distribution of older bedridden patients, it may occur in any location of the body and is an important consideration in the differential diagnosis of non-healing ulcers of the lower extremity.

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Pelvis and Lower Extremity Fractures Related to 4-wheeled Off-road Vehicles: Trends from the NEISS Database

Alejandro Esparza, Charlotte Lenz, Elizabeth Rivenbark and Chloe Meyers
Mentors: Jordan Johnson, DO and G. Robert Cummings, DO

Context: We sought to characterize the trends in pelvis and lower extremity orthopedic injuries resulting from 4-wheeled ORV use between 2012 to 2021. Literature suggests that use of ORV on public roads is associated with higher injury severity scores and higher fatality rates compared off-road accidents. Other studies have reported on injury severity and mortality from ATV and other types of ORV accidents, but none specifically evaluated the orthopedic injuries of the lower extremity and pelvis.

Objective: Four-wheeled off-road vehicles (ORV) are popular for recreational and occupational activities as well as on-road transportation. The purpose of this paper is to characterize and report on the most recent trends in pelvis and lower extremity orthopedic injuries treated in United States (US) emergency departments (ED) from 2012-2021.

Methods: We queried the National Electronic Injury Surveillance System (NEISS) database for injuries presenting to US ED involving ORV from 2012-2021. The query included injuries to the lower trunk and lower extremities involving 4-wheeled ORV that presented to participating US ED from 2012-2021. Adult (age ≥18 years) and pediatric (age <18 years) patients were included in the query and final data. The authors evaluated totals and trends across the data, which were then compiled and reported descriptively.
Results: There were 1,944 lower extremity and pelvis injuries in 1,892 patients treated by NEISS-participating ED in the US from 2012-2021. The average age of all injured patients was 28.4 years old. There were 1149 fractures (95.4%), 7 amputations (0.6%), and 49 dislocations (4.1%) in the adult population. Pediatric patients sustained 699 fractures (94.6%), 9 amputations (1.2%), and 31 dislocations (4.2%). Adult lower extremity fractures most commonly occurred in the lower leg (356, 31.0%), ankle (215, 18.7%), foot (164, 14.3%), and pelvis(156, 13.6%). In pediatric patients, the most common fractured body parts were the lower leg (249, 35.6%), upper leg (138, 19.7%), foot (123, 17.6%), and ankle (85, 12.2%). Adults had a notable increase in fractures in the last 3 years of the available database information, primarily from an increase in ankle, knee, and pelvis fractures in that time.
Conclusion: ORV-related injuries continue to increase with the growing use and ubiquity of ORV. Rates of lower extremity orthopedic injuries are increasing, especially since 2018, with more annual ankle, knee, and pelvis fractures. This information should be used by the trauma community to advocate for greater awareness of ORV dangers and to encourage legislation for ORV safety.

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Preventative Effect of Non-steroidal Anti-inflammatory Drug Use and Impact of Floor Exercise Equipment on Achilles Tendon Ruptures in Female Collegiate Gymnasts

Emily C. Muhlenhaupt
Mentors: Harald M. Stauss, MD, PhD

Context: Around 17% of female collegiate gymnasts experience Achilles tendon ruptures throughout their athletic career[1,2]. Chronic overtraining may promote tendinitis that weakens the tendon and ultimately results in ruptures during difficult gymnastics skills that put high strain on the tendon. This is likely to occur specifically during competitions when gymnasts engage in challenging routines and are under high pressure to perform at their best, which may indirectly impact biomechanics.
Objective: The hypothesis of this study was that overtraining in female gymnasts results in chronic inflammation of the Achilles tendon which may result in tendon ruptures particularly when athletes perform demanding skills while under competitive pressure. To test this hypothesis, we investigated if anti-inflammatory drugs prevent Achilles tendon ruptures and if Achilles tendon ruptures occur more frequently during competition than during training.
Methods: Coaches and athletic trainers from 78 US collegiate female gymnastic teams were asked to invite their active athletes and alumni to complete a survey consisting of 34 questions. The survey assessed the prevalence and characteristics of Achilles tendon ruptures, non-steroidal anti-inflammatory drug (NSAID) use, age at which competitive gymnastics started and age at which Achilles tendon rupture occurred, and whether Achilles tendon ruptures occurred at the training or competition sites.
Results: 103 female NCAA gymnasts were included in the study. Of those, 21 (20.4%, 95% CI: 13.6% to 29.4%) experienced an Achilles tendon rupture. 19 ruptures were full ruptures and 2 were partial ruptures. 19 ruptures occurred while performing floor exercises, one on vault, and one was unspecified. Of the 21 ruptures, 20 occurred during takeoff. The prevalence of NSAID use was higher in gymnasts without tendon rupture (27.6%, 95% CI: 18.6% to 39.0%) compared to gymnasts with rupture (5.5%, 95% CI: 0.6% to 35.5%). This effect of NSAID use was confirmed by multiple linear regression analysis, identifying NSAID use ($P<0.05$) and the age at which competitive gymnastics training was started ($P<0.01$) as negatively predicting factors, suggesting that NSAID use and a higher age at which competitive gymnastics is started protect from Achilles tendon ruptures. In average this cohort of gymnasts trained for 983±23 h/year (95% CI: 938 to 1028 h/year) at their home training sites. Assuming gymnasts went to an average of 12 competitions per year with an average of 3 h of gymnastics per competition site, gymnasts would spend an average of 36 h/year competing at various competition sites. Thus, gymnasts spend 27 times more time performing gymnastics at their home training site compared to external competition sites. Yet, similar numbers of Achilles tendon ruptures occurred at training sites (n=9) and competition sites (n=10). Two of the 21 gymnasts with Achilles tendon ruptures, did not disclose the site of the rupture. When expressing these data relative to the training hours, Achilles tendon ruptures occurred 0.08±0.01 (95% CI: 0.06 to 0.11) times per 1000 training hours at the training site. In contrast, at external competition sites, Achilles tendon ruptures occurred 1.85±0.11 (95% CI: 1.60 to 2.10) times per 1000 competition hours ($P<0.05$). This correlates to 23 times more Achilles tendon ruptures per gymnastics hour at competition vs. training sites.
Conclusion: Our data, showing a protective effect of NSAID use and a higher relative incidence of

Achilles tendon ruptures at competition versus training sites, suggest that overtraining in female gymnasts results in chronic inflammation of the Achilles tendon which may result in tendon ruptures specifically when athletes perform demanding skills while under competitive pressure. Preventive use of NSAIDs may initiate self-regulatory and self-healing processes as proclaimed by Andrew Tailor Still and therefore reduce the high incidence of Achilles tendon ruptures in female gymnasts.

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♣

Abstracts - Session 4

Sex-Based Differences in the Incidence of Dual-Chamber Cardiac Implantable Devices

Rhea Kohli and Grace Hawley
Mentors: Jon Jackson, PhD, Bonny Ford, PhD, Carlos Soneira-Ruiz, MD, MS, Nancy Minugh-Purvis, PhD, and Kristopher Vaudrey, MA

Context: The incidence of dual-chamber pacemaker implantation, to prevent or treat congestive heart failure and associated conditions, varies notably between males and females. Dual-chamber pacemakers consist of two leads present in the right ventricle and right atrium, which act synchronously to mimic the natural sequential contractions of the chambers.[1] Previous studies have illustrated the complexity of cardiac device implantation in females as a result of differences in anatomy and physiology, disease progression and selection bias by physicians.[2] In this study, we aim to bridge the findings from our cadaver dissection with existing literature, and highlight the significance of sex-differences in the incidence of dual-chamber cardiac devices.
Objective: To analyze the difference in incidence of dual-chamber pacemaker implantation between males and females.
Methods: An 89-year-old female with a history of congestive heart failure, atrial fibrillation, chronic obstructive pulmonary disease, and chronic kidney disease, donated her body to the Burrell Anatomical Gifts Program after death due to pneumonia with emphysema. Cadaver dissection was conducted in June of 2023 by four rising second-year medical students, following instructions according to Grant's Dissector: Volume 16. The Atlas of Anatomy: 4th edition was additionally used to guide the investigation. For dissection, No. 2 and No. 4 stainless steel scalpel handles were used with #22 and #10 blades. Following dissection, a literature review was conducted in order to analyze the incidence of dual-chamber devices in males and females.
Results: Through dissection, we isolated a Medtronic dual-chamber pacemaker in our 89-year old female cadaver. Additional notable findings included evidence of a hysterectomy, cholecystectomy, appendectomy, right lung inferior lobe atrophy with presence of exudate, spinal cord pain device implantation and a split right piriformis muscle. Through literature review, we assessed the application of our findings. Previous studies have shown with increasing age, less dual-chamber system implantation occurs, with males receiving devices more often than females.[2] A German study depicted this difference, as out of 9,405 male patients, 63.7% received dual-chamber implantation, in comparison to 58.7% of 8,421 female patients.[2] In another study, out of 3,504 patients that received dual-chamber implantation, 65.2% were male and 34.8% were female.[3] Despite less incidence of implantation, long-term follow up showed higher survival rates in females than males, even with receiving the dual-chamber devices at significantly older ages.[2] In comparing 10-year survival rate, females presented with a rate of 44.6% and males with 39.5%.[3]
Conclusion: Most often, dual-chamber cardiac implantable devices are seen in men,[3] which is why our attention was heightened when finding the Medtronic dual-device in our female cadaver. Our study brings to light the gap between men and women receiving dual-chamber cardiac devices, despite women having longer post-implantation survival rates than men. Factors such as adverse effects, smaller body size[3], and body image concerns[4] may play a role in less women receiving pacemakers. However, as women have a better survival rate post-implantation[3], more research certainly needs to be conducted, in order for physicians to have a better understanding of the sex

differences when it comes to dual-chamber cardiac devices.

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Observations from a Post-radical Mastectomy Cadaver: Radical Mastectomy too Radical?

Rose-Mary Colon, Andie Evans, Mohini Vadalia, and Victoria Vicuña
Mentors: Bonny Ford, PhD and Jon Jackson, PhD

Context: Due to unique observations of a radical mastectomy and fibrotic clavipectoral fascia and bursitis on the right side of a 91-year old female cadaver during Burrell College of Osteopathic Medicine's Summer Dissection Experience, we investigated the implications of these findings and their complications post-mastectomy. Upon research, few bodies of work connecting both the anatomical phenomena with the statistical incidences reported in the literature were found.
Objective: To present observations of anatomical variation in our cadaver and a literature review that highlights the frequency of post-radical mastectomy complications that have implications coinciding with our observations. By incorporating data on incidence as well as personal observations, we highlight the adversity of healing from breast cancer and suggest therapeutic solutions.
Methods: Full dissection of a female cadaver was conducted over approximately 4 weeks under the guidance of the Burrell anatomy faculty. Grant's Dissector 16th edition was followed to systematically dissect our cadaver and notable findings were documented. Anatomical variations were recorded through photos taken of our specimen. The observed anatomic variations on the cadaver correlated with current reports of complications presented in post-radical mastectomy patients in surveys taken of patients in short and long-term studies.
Results: Through our dissection, we discovered that our cadaver was missing breast tissue bilaterally as well as her right pectoralis major muscle. A literature review indicated that these findings coincide with mastectomy procedures. We speculate a radical mastectomy was performed on the right, and a modified radical mastectomy on the left as the pectoralis major remained intact. The radical mastectomy procedure includes removal of: "The mammary gland, both pectoral muscles, and the entire axillary lymphatic tissue"[8]. The modified radical mastectomy procedure involves removal of only breast tissue and some pectoral fascia while sparing the pectoral muscles. The radical mastectomy is an approach that was phased out in 1972 and replaced with a modified version. This information gave us an estimate of when the cadaver may have undergone the procedure, which would have been around her 40th year of life. Due to the nature of the procedure, it may result in several complications including chest deformity and disability. However, such complications have decreased since the phasing out of removing musculature, and even now some speculate the procedure could spare the fascia as well if there is no evidence of malignant invasion. Bursitis is a condition that arises from overuse and positions that put pressure on the bursae around a joint. The removal of the right pectoralis major muscle may have resulted in stress to the bursa in the shoulder causing inflammation, as well as experiencing less use due to pain and lack of strength during certain motions, specifically adduction and medial rotation. Adhesive capsulitis is a condition with variable etiologies, cited in the literature resulting in patients post-mastectomy experiencing "loss of strength in adduction, abduction, extension, flexion, inner rotation, and outer rotation".[13]
Conclusion: Our dissection showed a 91-year old woman with resected breast tissue bilaterally, and a resected pectoralis major on the right accompanied by a fluid-filled bursa inferior to the deltoid and fibrotic fascia inferior to the clavicle. We have limited information about our donor (age, sex, and cause of death), but our observations point to a mastectomy and adaptive changes to the shoulder and clavipectoral fascia. We discovered that radical mastectomies

are extensive in removal of tissues surrounding the breasts, affecting range of motion and mobility as well as lymphatic drainage in the axilla. We cannot say for certain that the radical mastectomy was the cause of the symptomology of the right pectoral girdle but they may be associated as none of these changes were noted on the left where the pectoralis major was preserved.

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Utilization of ChatGPT to Enhance Medical Education

Maha Ali, Nicholas Hunt, Khanhtran Anna Levu, and Samuel Stewart
Mentor: Joseph N. Benoit, PhD

Context: Artificial Intelligence (AI) is an emerging technology that many professions have started to utilize within their respective fields, including many students using open AI as a supplemental study tool. Since open AI is a relatively new technology, we noticed a gap in the literature that would confirm its ability to generate practical study material. Thus, our goal is to evaluate the effectiveness of ChatGPT within medical education using preexisting standards such as Bloom's Taxonomy and the Hand Test.

Objective: To explore the use of ChatGPT as a supplemental study tool for first-year osteopathic medical students. Specifically, our study focused on the utilization of ChatGPT to generate: 1) Diverse and relevant patient profiles based on a variety of clinical and demographic characteristics, 2) Concept maps of lecture material that expand on the instructor provided information, and 3) Multiple-choice questions based on lecture objectives and outlines. Finally, we sought to evaluate the degree of consistency among ChatGPT responses with similar prompting but along different user profiles.

Methods:

1. Development of Patient Profile by AI: Each researcher independently developed a patient profile based on health conditions discussed in first-year medical education along with various diverse demographic features to create nuanced patient profiles with the goal of linking basic science concepts, clinical, and osteopathic relevance.

2. Development of Clinical Concept Maps: Using overarching concepts including Diabetes and Wound Healing, members of the team independently prompted ChatGPT with the same or similar prompts. Within the Diabetes dialogue, researchers followed the same set of basic prompts with more open-ended questions. For the Wound Healing dialogue, researchers used similar wording focusing on the same content. Responses were analyzed for content discussed and for consistency in responses.

3. Development of Multiple-Choice Study Questions: The research team used identical OMS1 Lecture outlines and uniquely prompted ChatGPT to create a series of multiple-choice study questions. Then, a rubric was developed to rate questions based on whether the question stem contained enough information to prompt a specific answer (Hand Test), and Bloom's Taxonomy (Krathwohl, 2002). The Hand Test was used to evaluate whether a question had a clear, answerable stem, and Bloom's taxonomy can help classify the level of thinking necessary to answer correctly. Researchers prompted ChatGPT to evaluate the questions along Bloom's taxonomy for concordance.

Results:

Development of Patient Profiles: Within different chats, AI yielded varying levels of information and narratives about patient presentation and history. When provided with an age and gender AI provided symptoms, conditions, and medications that could realistically exist in the population. When prompted, AI incorporated culturally diverse populations within its patient profile, including South Asian Immigrants, LGBTQIA+ identities, and Latin ethnicities. ChatGPT provided key insights about the individual's basic health needs while elaborating on specific needs for the given unique context. Providing different terms like "presentation", "profile", and "story" produced a range of different writing tones and descriptions.

Development of Clinical Concept Maps: Within the Diabetes dialogue, individuals' responses from the same prompts were analyzed for consistency. Researchers noted similarities in the content of the response, however the style and formatting of the responses varied. For our Wound Healing concept maps, prompts were more focused, beginning with prompting for explanations of concepts, then prompting ChatGPT to explain further. With similar prompts, between different user accounts, the formatting and content varied significantly.

Development of Multiple-Choice Study Questions: Questions along each variable were first measured for concordance, with questions receiving less than 75% concordance excluded from the data. 97% of generated questions passed the Hand Test. Along Bloom's taxonomy, all 63 questions were along the lower 3 tiers, with 34 Remember, 16 Understand, and 9 Apply questions. There were 0 questions that tested the ability to Analyze, Evaluate, and Create. On Bloom's taxonomy, ChatGPT was not able to consistently rate the multiple choices questions that it generated. In comparison to the human raters, which had a concordance of 93.7% with benchmark, ChatGPT had 69.8% concordance with itself.

Conclusion:

Development of Patient Profiles: ChatGPT is able to provide a nuanced response that is critical to expanding first year medical knowledge. The conversations revealed cultural distinctions that would impact the patient's healthcare.

Development of Concept Maps: Conceptual roadmaps generated via ChatGPT have the potential to help students link concepts between different lecture presentations and implement them into their knowledge pool. From our utilized lecture materials, ChatGPT was able to bridge the gap between the outlines and other concepts, but was inconsistent in the responses provided, even with similar prompts. We suggest that students may be able to advance their understanding of course material in a holistic manner using this approach. The multiple-choice questions produced in the individual responses shared the same consistency of concepts tested. Showing that giving the same consistent prompts with open-ended questions, ChatGPT can provide supplemental practice questions testing the same concepts with little discrepancies.

Development of Multiple-Choice Study Questions: Given the prompts utilized, we found that ChatGPT was effective at developing questions along the lower levels of blooms taxonomy. This indicates that given the initial prompts, these questions may be effective at

supplementing basic comprehension. However, to reach higher levels of comprehension, greater complexity needed to be prompted from ChatGPT, with tenuous improvement along Bloom's taxonomy. Furthermore, we noticed that ChatGPT was unable to evaluate its own question consistently, revealing a potential shortfall in ChatGPT.

Final Thoughts: Based on this preliminary study, if used and prompted in a consistent manner, ChatGPT has potential to be an effective supplemental study tool. Future work would involve developing more consistent prompts to effectively generate more complex levels of questioning along with testing the practical efficacy of ChatGPT as a learning tool.

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Equal contributions were made by each member of the research team.

Awards

First Prize

First Prize is a special dining evening for the winning researchers and their mentor with President Hummer. Time and location to be announced.

Second and Third Prize

The second and third place winners will be provided with a certificate and a recognition letter from the Assistant Dean of Research.

Judging Criteria

Poster Presentation Scoring: The judges will score the poster presentations according to the Poster Presentation Rubric listed below. Based on the scores six finalists will be selected that will present their research during the oral Award Finalist Presentation Session.

Finalist Presentation Scoring: Following the oral finalist presentations, the audience will vote on the first, second, and third prize winners.

Poster Presentation Rubric

Standards	Exemplary (5-4)	Satisfactory (3-2)	Unacceptable (1-0)
Content	Strong material. Well summarized. Clearly shows development of study or research. Material appears to accurately support purpose of study, hypothesis, or research question. Strong conclusion and implications presented.	The content was adequately presented but support for the study, research hypothesis, or question(s) is somewhat general. Conclusion and implications were reasonable.	Connection not found between poster content and purpose of study, research hypothesis/question(s), method, conclusions, or implications.
Depth of knowledge	Demonstrates substance and depth; is comprehensive; shows mastery of material, main points were clearly presented.	Covers topic; shows marginal adequate mastery and is objective; main points were adequately presented.	Does not give adequate coverage of topic; poor mastery of subject, main points were poorly presented.

Organization of content	Presentation is strongly ordered and easy to follow; visual elements (if any) are clearly arranged and synchronized with presentation.	Presentation order and clarity is of acceptable quality; slightly difficult to follow; visual elements (if any) are somewhat arranged and synchronized with presentation.	Presentation order and clarity of transitions is of poor quality or below; visual elements (if any) may be difficult to follow or out of synch with the presentation.
Delivery and clarity of presentation	Has natural delivery; modulates voice; is articulate; projects enthusiasm, interest, and confidence.	Has appropriate pace; has few distracting mannerisms; is easily understood.	Is often hard to understand; has voice that is too soft or too loud; has a pace that is too quick or too slow; demonstrates several distracting mannerisms.
Ability to respond to questions	Demonstrates full knowledge of topic; explains and elaborates on all questions.	Shows ease in answering questions but does not elaborate.	Demonstrates little grasp of information; has undeveloped or unclear answers to questions.

Poster Judging

Students are expected to be at their poster during the time period listed in the program and in the table below. During that time period judges will visit the posters and discuss them with the presenting authors. Each competing poster will be visited by the assigned judge as listed in the table below. However, *other judges may also visit the competing posters* during the indicated time period.

Judge	Posters	Time
Dr. Mark Benson	P01, P06, P08, P12, P20	9:10-10:50
Dr. Adrienne Kania	P02, P09, P11, P18, P19	9:40-11:20
Dr. Spencer Mattingly	P03, P13, P16, P17	10:10-11:30
Dr. Pedro Del Corral	P04, P05, P10, P14	10:30-11:50

Author Index

The greatest scientists are also the greatest dreamers, constantly envisioning new possibilities and exploring uncharted territories of the mind.” - Jane Goodall

Baroness Jane van Lawick-Goodall (Born 1934), British Primatologist and Anthropologist

AUGUST 12, 2023

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