SOUTHERN BIOMEDICAL ENGINEERING CONFERENCE

41st Annual Meeting

September 11-14, 2025

Host: The University of Texas at Tyler

http://sbeconference.org



Program



Program Chair: Dr. Santosh Aryal, University of Texas at Tyler (santosharyal@uttyler.edu**)**

Dr. Santosh Aryal received his Ph. D. in Bionanosystem Engineering from Chonbuk National University, the Republic of Korea in 2007. He was a postdoctoral associate in the Department of Mechanical Engineering, University of Wisconsin, Milwaukee, and at the Department of Nanoengineering and the Moores Cancer Center, University of California, San Diego. After completing four years at Moores Cancer Center, he moved to the Department of Translation Imaging, Houston Methodist Research Institute, Houston, Texas, where he was working in the broad spectrum of Nanomedicine for the diagnosis and treatment of cancer and vascular diseases. He holds B.S. and M.S. degrees in Chemistry from Tribhuvan University, Kathmandu, Nepal. After completing six years of independent research as an Assistant Professor at the Department of Chemistry and the Nanotechnology Innovation Center of Kansas State (NICKS), Dr. Aryal joined the University of Texas at Tyler (UT Tyler) as an Associate Professor of the Department of Pharmaceutical Sciences and Health Outcomes. At UT Tyler, his research group is continuously working to address a fundamental question in drug delivery: how medicine is robustly tuned to communicate with the immune system for cooperative treatment. Research activities in Aryal Lab are supported by the University of Texas, the National Science Foundation (NSF), and the National Institute of Health (NIH).



Program Vice-Chair: Dr. Amol Janorkar , University of Mississippi Medical Center, Jackson, MS, USA, ajanorkar@umc.edu

Amol V. Janorkar received his B.S. in chemical engineering from University of Mumbai Department of Chemical Technology (UDCT) in 2000 and his Ph.D. in chemical engineering from Clemson University in 2005. Subsequently, he did a two-year postdoctoral research fellowship at the Center for Engineering in Medicine with a joint appointment at the Harvard Medical School, Massachusetts General Hospital, and Shriners Hospital for Children. He joined the faculty of the Department of Biomedical Materials Science, School of Dentistry at the University of Mississippi Medical Center (UMMC) in August 2007 as an Assistant Professor. Dr. Janorkar was promoted to the rank of Associate Professor (with tenure) in July 2013 and then to the rank of Professor in July 2017. Beginning in July 2020, Dr. Janorkar was entrusted with the responsibility of being the Chairperson for the Department of Biomedical Materials Science. In his other administrative service roles, Dr. Janorkar is serving as the Professional Development Liaison for the School of Dentistry, the Chair of the UMMC Intellectual Property Committee, and the Co-Director of the NIH-funded Mississippi Center for Clinical and Translational Research (MCCTR) Mentoring Academy. With his training and experience in the field of biomaterials and tissue engineering over the past 23 years, Dr. Janorkar leads a research group that focuses on cell-biomaterial interactions to direct cell morphology and ultimate cell function. The Janorkar Lab uses chemical and physical modification of biopolymer substrates to create three-dimensional in vitro tissue models that achieve enhanced survival and biological function versus conventional cultures for liver, adipose, and bone tissue engineering. His research has been funded by the National Science Foundation (NSF), the National Institutes of Health (NIDCR and NIBIB), and the United States Department of Agriculture (USDA). Dr. Janorkar has published over 70 journal articles and 50 conference proceedings. Dr. Janorkar and his students have made over 100 conference presentations. Recognizing these research accomplishments, the University of Mississippi Medical Center has awarded Dr. Janorkar the Gold, Silver, and Bronze Medallions for Research Excellence. Dr. Janorkar served as the founding Director of the summer research program that has trained over 250 dental and undergraduate students over past 15 years. Recognizing his contributions to dental research, he has been inducted into the Omicron Kappa Upsilon National Dental Honor Society, which rarely inducts non-dentist faculty members. Dr. Janorkar also served as the Director of the Ph.D. graduate program with focus on Biomedical Materials Science from 2016-2020. He continues to serve as the director and course faculty for dental and graduate courses. Dr. Janorkar has mentored over 80 graduate, undergraduate, dental, and medical students and post-docs. His students have won 44 awards for outstanding research at local and national levels. Recognizing his teaching and mentoring, Dr. Janorkar was awarded the TEACH (Toward Educational Advancement in Care and Health) Prize, the highest award given to an educator by the University of Mississippi Medical Center. He has also been inducted into the Nelson Order of Teaching Excellence and the UMMC Academy for Excellence in Education (AEE). Dr. Janorkar currently serves as the President of the AEE. Dr. Janorkar is a senior member of the American Institute of Chemical Engineers (AIChE) and an active member of the Society for Biomaterials (SFB).

41st SOUTHERN BIOMEDICAL ENGINEERING CONFERENCE



Conference-Co-Chair: Dr. Michelle Tucci, University of Mississippi Medical Center (mtucci@umc.edu)

Dr. Tucci is a Professor of Anesthesiology at the University of Mississippi Medical Center in Jackson, MS. Dr. Tucci has been involved in a leadership role for various state, national and international organizations. After completing her undergraduate training at Seton Hill University, in Pennsylvania she completed a Master's degree in Biology at the University of Dayton in Ohio. Following her move to Mississippi, she completed her PhD in Pharmacology and Toxicology in 2000. Aside from her work supervising and overseeing resident's basic science research, she has also mentored and supervised a number of undergraduate and graduate students from diverse disciplines. She has served on over 80 doctoral dissertation committees, has published over 300 full journals. Her leadership role in various societies includes Director and program chair at the Rocky Mountain Biomedical Engineering Society; Program Chair at the Academy of Surgical Research, Program and conference organizer at the Southern Biomedical Engineering meetings, Chair of Pathology Implant SIG at the Society for Biomaterials, to name a few. She served/serving in editorial boards for several and she is serving as Chief Editor of the Biomed Science Instrumentation and Chief Editor for Journal of the Mississippi Academy of Sciences. Previously, she has been recognized for her work and service by the Academy of Surgical Research, the Mississippi Academy of Sciences Outstanding Contribution to Science, Peeler Dudley Outstanding Service Award, Douglas Walker Award, C. Hall Award, Outstanding Contribution to Biomedical Engineering and recently was inducted as fellow in American Institute of the Biomedical and Biological Engineering.



Conference-Co-Chair: Dr. Ham Benghuzzi, Mississippi Academy of Sciences and JSU, ***msacademyofscience@gmail.com***

Dr. Benghuzzi is the executive director of Mississippi Academy of Sciences and Engineering and Distinguished lecturer at Jackson State University and Consultant in the effectiveness of Biomedical. devices. Prior to that he was a Professor at the University of MS Medical Center and chaired three departments as well as directing the PhD program during his 27 year tenure. He is known nationally and internationally as a pioneer in Ceramic Drug Delivery Systems. He has over 350 PubMed indexed articles and over 800 abstracts detailing the release characteristics of various biologicals from the bioceramic carriers. He has trained (major advisor) to 44 PhD students and served as a member for over 100 PhD committees. He has mentored students at all levels (from high school, undergrad, grad, post doc and faculty). He has served as a mentor for residents and faculty on more than 10 funded grants. He has been in research leadership roles in many organizations such President of the Academy of Surgical Research, President of International Society of Ceramics in Medicine (ISCM), President of Mississippi Academy of Sciences and Engineering, currently serving as a President of the International Biomedical Sciences Instrumentation Symposium (IBSIS)/Rocky Mountain Bioengineering Symposium, and also organized and chaired several regional, national and international society programs. He has also served on numerous NIH special emphasis panels including RO1, R-25, K01, KO8, T-35, and the P-60 center grants. In addition, he has received numerous awards from various organizations during his career. He was listed as Most Cited Scientist in Stanford University's Study of top 2% Most Cited Scientists in Biomedical Engineering worldwide. A few of his awards included: (1) The Presidential Award from the RMBS, (2) Presidential Award from SEM International, (3) the Endocrine's Society Outstanding Investigator Award, (4) MAS Contribution to Science Award, (5) The MAS Dudley Peeler Award, and (6) HEADWAE Award, (7) C. Hall Award, Outstanding Contribution to Biomedical Engineering (32nd SBEC), and (8) ISCM Excellence Award from the International Society for Ceramics in Medicine. He was invited as a keynote/plenary to speak at state, national and international levels including recent invitations in Japan, France, Italy, Spain, Greece, China, Poland, Dubai and Canada. He is a fellow of the American Institute for Medical and Biological Engineering (AIMBE), Mississippi Academy of Sciences and Engineering, as well as an International Fellow of Biomaterials Science and Engineering (FBSE).



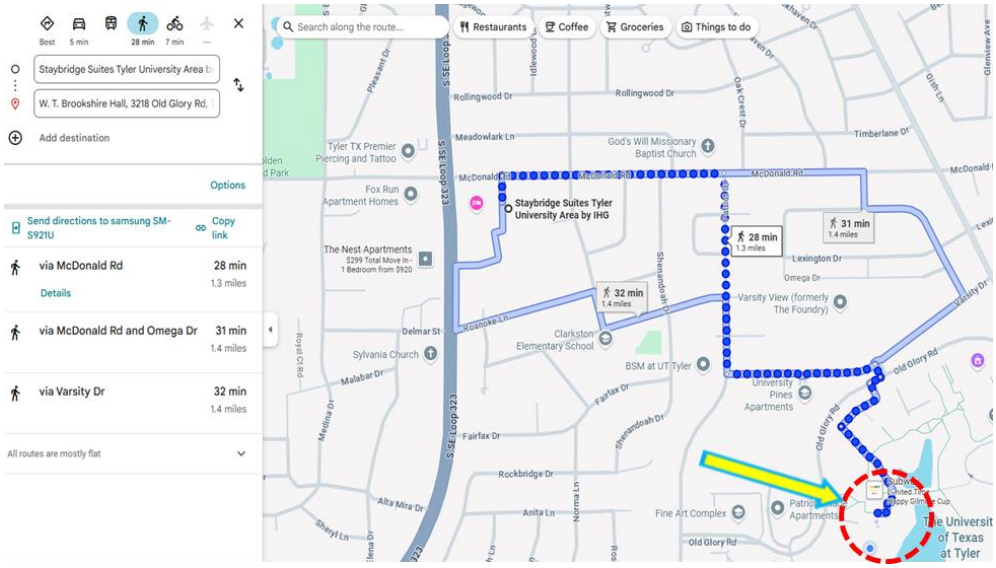
Immediate Past Program Chair: Dr. Giovanni F Solitro, Louisiana State University Health-Shreveport (giovanni.solitro@lsuhs.edu)

Dr. Giovanni F. Solitro is an Associate Professor and the Director of Biomechanics Research and Education at Louisiana State University Health in Shreveport. He earned his first PhD in Mechanical Engineering in 2010, focusing his dissertation on patient-specific modeling of the human spine. In 2015, he completed postdoctoral training at the University of Illinois at Chicago (UIC), where he continued as a Senior Research Specialist in the Department of Orthopedics. During his tenure at UIC, he pursued a second PhD, with his dissertation centered on intraoperative assistance in pedicle screw placement. He serves on the editorial boards of leading journals in bioengineering and orthopedics and is a voting member of the ASTM Medical and Surgical Materials and Devices Committee. He has authored numerous peer-reviewed publications in orthopedics and biomedical engineering, with his work earning international recognition and prestigious awards from academic institutions and scientific organizations. In his current role, Dr. Solitro is committed to improving patient outcomes by advancing the understanding of the body's mechanical systems. His primary expertise lies in the advanced modeling of joints to enhance the precision of orthopedic surgery. His research interests encompass surgical skill training, knowledge-based orthopedics, total hip replacement, and biomechanics of the spine, and intraoperative navigation.

Direction to Conference Site: 13. WT Brookshire Hall (WTB)/Fisch College of Pharmacy



Staybridge Hotel and La Quinta Inn and Suites Share their parking



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MAS

Mississippi Academy of Sciences

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MDPI Journals

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pathophysiology

biomedicines

Endorsement:

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Society For Biomaterials
Giving life to a world of materials


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At the Fisch College of Pharmacy, our student-centered approach combines academic rigor with real-world application, giving every learner the tools to succeed in a fast-changing healthcare landscape and to make a positive impact in their communities.
100% Residency Match*
UT Tyler Fisch College of Pharmacy is proud to have the highest residency match rate in Texas and the nation.
#1 in Texas for MPJE pass rates*
#3 in Texas for NAPLEX pass rates*
*Based on 2025 graduating class.

Program and Organizing Committee

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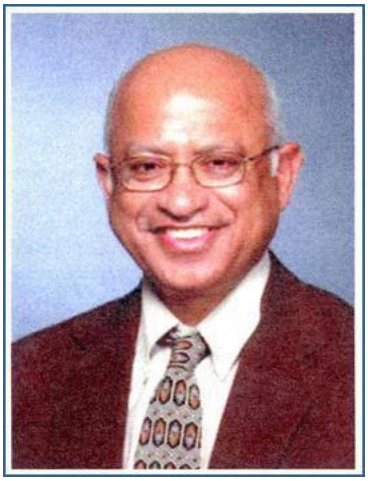
SBEC HISTORY



The Southern Biomedical Engineering Conference (SBEC) series was conceived by bioengineering professionals from academia and industry located primarily in the South of the United States in 1982. The first Southern Biomedical Engineering Conference was held in Shreveport, LA, at the LSU Health formerly LSU Medical Center, in 1982 organized by the founder of SBEC Dr. Subrata Saha (photo). Since then, it has been held annually in different cities, mostly in the southern United States, and has grown to become a global event that regularly attracts attendees from all over the world. Submitted Papers are peer-reviewed, and those papers accepted for presentation and publication appear in the yearly issue of SBEC proceedings.

The SBEC serves a special purpose by emphasizing participation from young professionals and advanced students. Since established investigators present papers in the same sessions with the students, it encourages a high level of professionalism as a standard for young investigators and students. Submission of papers from individuals from around the world is encouraged. However, if their papers are accepted, an author or co-author must attend the conference to present their work and to interact with other attendees. In keeping with the emphasis on student participation, the SBEC presents the best paper and presentation awards to undergraduate, graduate, and professional students.

Conference Information

The format of the conference is to have four concurrent sessions, with each presentation limited to 15 minutes (12-minute presentation and 3-minute discussions). Room assignments for each session is posted at the sessions below and entire program can be accessed at the conference website.
Poster presentations will also be held on the site listed below. The poster display dimensions are: 48" wide x 36" length. Push pins and tapes will be provided (poster format should include: Title, Authors, Affiliations, Introduction or background, Methods, Results, Discussion and summaries, References and Acknowledgments.

The Conference will be held at the WTB Pharmacy building, University of Texas at Tyler (please see map above for directions).

All the accepted abstracts/papers will be published in an archival proceeding program book. The program review committee selected limited number of abstracts to submit full-length manuscripts (optional to authors) to be published in the peer-review prestigious journal:

Biomedical Science Instrumentations (IAE Publisher). Manuscripts are subject to a Publication fee of $90 if accepted.

Student Awards: Top undergraduate and graduate students as well as post doc/residents for podium and poster presentations will be recognized at the awards ceremony on Sunday at noon. Winners must be present for cash prizes of the awards (Cash and Certificates). Failure to attend the awards ceremony will void the cash portion of the awards.

Registration

Registration* Fee includes access to all conference events, program copy, lunches, banquet, coffee breaks and snacks. On-site registration will continue all day Friday, Saturday, and Sunday morning. More information in how to register can be found at: http://sbeconference.org.
**PayPal with credit card option*

Category	Before July 12	After July 12
Investigators/Staff	$375	$475
Students	$225	$375
Companion*	$150	$180
Publication Fee	$90	$90

- **Companion fee includes access to event functions and excludes attending or presenting in the scientific sessions.**
- **Registrations after July 12, 2024 is nonrefundable due to placing orders for event functions.**
- **Failure to register or no show will result in removal of abstract from program post meeting.**

Hotel Information: Detailed information for each hotel can be found on fourwaves, sbeconference.org

Local Arrangement Committee at UT Tyler:

1. **Dr. Ayman K Hamouda, Chair**
2. **Dr. May Abdelaziz, Vice Chair**
3. **Dr. Farah Deba, Member**
4. **Dr. Dustin Patterson, Member**
5. **Dr. Shashi Kant, Member**
6. **Dr. Premananda Indic, Member**
7. **Ms. Angela Nunez, Member**



https://www.tripadvisor.com/Attractions-g56797-Activities-Tyler_Texas.html

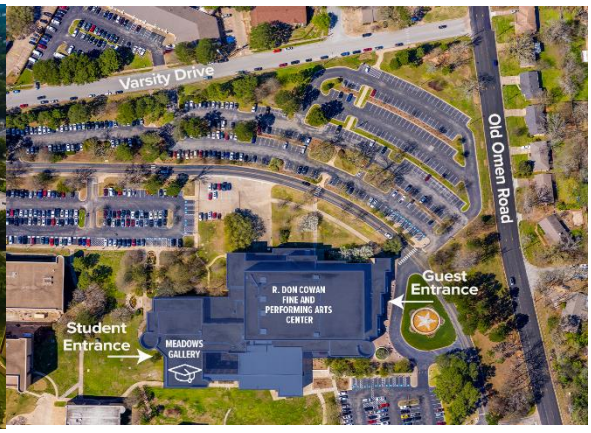
41st Annual Meeting

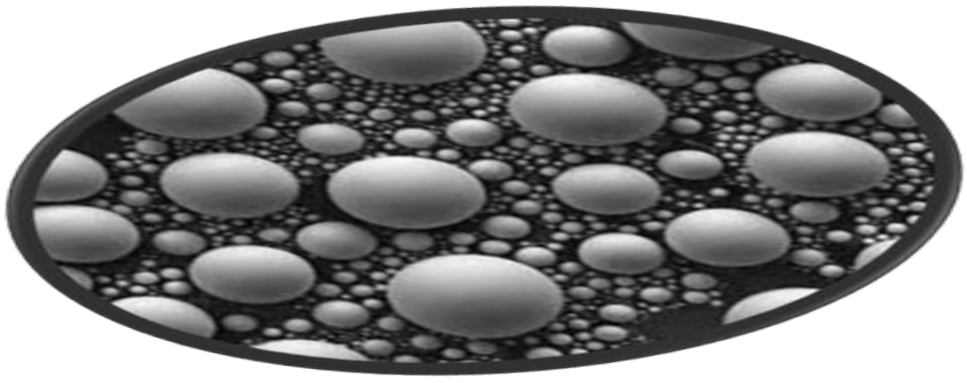
Program

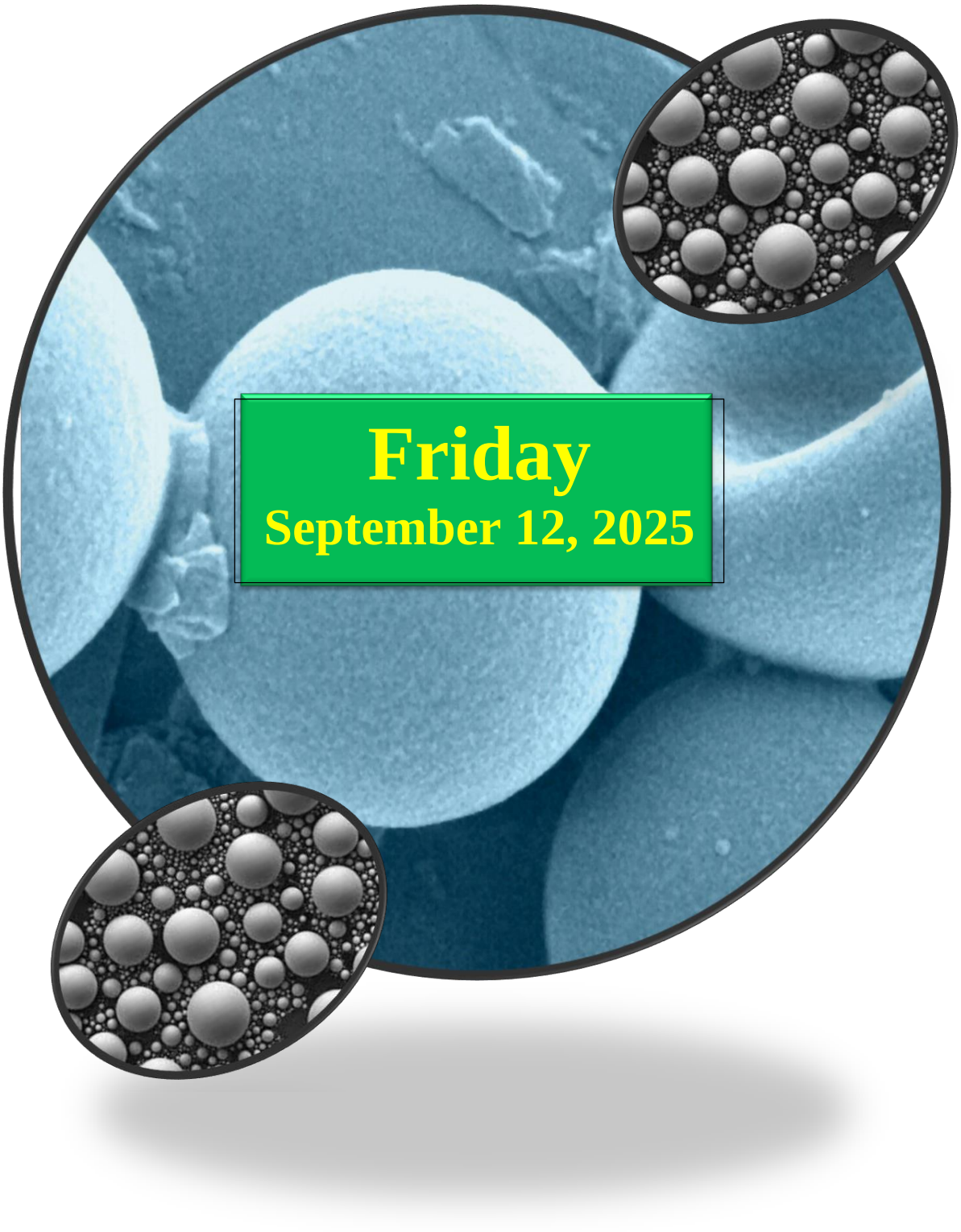
Thursday, September 11, 2025

4:00 PM-6:00 PM: Registration at UT Tyler, WTB School of Pharmacy









Friday
September 12, 2025

Friday, September 12, 2025

7:00 am – 6:00 **Registration**

7:30 am **Conference Opening, Room# WTB 133**

Program Chair

Santosh Aryal, Ph.D

Program Vice-Chairs

Amol Janorkar, PhD

UT Tyler Host Welcoming Remarks:

Dean: Pamella Ochoa, Pharm.D

MAS President: ***Dr. Jamil Ibrahim***

Conference Co-Chairs

Dr. Michelle Tucci, and Dr. Ham Benghuzzi

8:15- 8:30 Coffee Break Visit the Posters

Meeting at Glance

Friday Sessions		
WTB 133	**WTB 136**	**WTB 137**
Session 1-Biomechanics 1 **8:30-9:30**	**Session 2**-Nanomedicine and Drug Delivery I 8:30-9:45	**Session 3**-Medical Imaging 8:30-9:45
Session 4-AI Applications for Healthcare and Environment **10:00-11:30**	**Session 5**: Modeling 10:00-11:30	**Session 6**: Nanomedicine and Drug Delivery II 10:00-11:30

11:45-1:00: Room #WTB 133

Plenary Speaker 1 and Lunch (Friday 12th Sep, 2025)

Moderator: Dr. Rahmat Talukder, PhD. Head of the Department of Pharmaceutical Sciences and Health Outcomes, The University of Texas at Tyler

Gang Bao, PhD,

Department of Bioengineering, Rice University, Houston, TX

Title: Nanomedicine and Genome Editing Approaches for Disease Therapies

Session 7: Chemical Engineering **1:15-3:00**	**Session 8**: Cardiovascular: Impact of Obesity, Drug Abuse, and Chemotherapy in Cardiac Health and Therapies 1:15-2:45	**Session 9**: Neuroscience 1:15-2:45
Session 11: Nanomedicine and Drug Delivery-III **3:15-5:15**	**Session 12**: Targe cell signaling in chronic diseases 3:00-5:00	**Session 10**: Neuroscience-Neuromodula n II 3:00-4:30
4:30-6:00: Poster Session [Authors must be at their posters] **Room #: WTB Atrium** **Chair: Ibrahim Farah** **Co-Chairs: Michelle Tucci, Jamil Ibrahim, Santosh Aryal, May Abdelaziz, Ayman Hamouda** **Notes: Posters will be displayed until Saturday at 5:00 PM to allow judges to complete evaluations (do not remove posters)**		
4:30-6:30: Workshop-1 , Room #: WTB 137 **Chair: Hamed Ali, PhD, Texas A&M College of Pharmacy** **Cochair: Eneye Ajayi, Texas A&M University, College of Pharmacy**		
7:30-10:00 Program Committee Meeting		**Room #: UC Ball Room**

End of Friday

Saturday Sessions			
WTB 133	**WTB 136**	**WTB 137**	**WTB 234**
Session 13: Innovative Polymeric Biomaterials **7:30-9:15**	**Session 14**: Electrophysiology and Neuromodula n 7:30-9:00	**Session 15**: Ethical Issues in Biomedical Engineering & Den try 7:30-8:45	**Session 16**: "From Atoms to Algorithms: Medicinal Chemistry and CADD for Next-Gen Therap " 7:30-9:30
Session 17: Clinical Rehab **9:30-11:00**	**Session 18**: Nanomedicine 9:30-11:00	**Session 19**: Biology and Biochemistry 9:30-11:00	**Session 20**: AI Ethics 9:30-10:45
Session 21: Biomechanics II **11:15-12:15**	**Session 22**: AI and Wearable Technologies for Smarter Healthcare Outcomes 11:15-12:30	**Session 23**: Career Development Panel 11:15-12:15	**Workshop-2** by Tyler Univ Room Chair: Angela Nunez; Director, O e of Sponsored Programs, The University of Texas at Tyler 11:15-12:15
12:30-1:30 Symposium on Biomaterials Trend, Lunch provided, Room# WTB 133 **Moderator: Dr. Amol V. Janorkar, University of Mississippi Medical Center**			

Session 24: Medical devices and implants 1:45-3:15	**Session 25**: Molecular and Tissue Engineering 1:45-3:15	**Session 26**: Signaling Pathway 1:45-3:15	**Session 27**: Nanomedicine and Drug Delivery IV 1:45-3:45
Coffee Break (3:30-3:45)			
Session 28: AI-enhanced Biosensing and Energy Harvesting 3:45-5:30	**Session 29**: Biomaterials, Room 3:45-5:30	**Session 30**: Nanomedicine 2 3:45-5:30	**Session 31**: Biomedical Educa n/Research Training 3:45-6:00

7:00 PM Subrata Saha Outstanding Speaker Event and Banquet

Room #: UC Ball Room

Moderators: Dr. Ham Benghuzzi and Dr. Michelle Tucci

UT Tyler Welcoming Remarks: Dr. Barbara Haas, Provost, UT Tyler

Distinguished Speaker and Awardee:

Catherine Ambrose, PhD, FORS

Department of Orthopaedic Surgery, UTHealth Houston, TX

Title: "The Support Within – What I have Learned from Bone Research"

End of Saturday

Sunday Sessions

WTB 133	WTB 136	WTB 137
Session 32: Orthopaedics 8:30-10:00	**Session 33**: Biomaterials II 8:30-10:00	

Plenary Speaker 2 Room#: WTB 133

10:15-11:15 Host: Dr. Santosh Aryal, PhD. Associate Professor, Pharmaceutical Sciences and Health Outcomes, The University of Texas at Tyler

Presenter: Paolo Decuzzi, PhD,

Senior Scientist and the Founding Director, Laboratory of Nanotechnology for Precision Medicine, Italian Institute of Technology, Genova (Italy) & Stanford University School of Medicine, Stanford (USA)

Title: Engineering Precision Therapies: A Multidisciplinary Approach to Hierarchically-Structured Drug Delivery Systems

General Assembly & Student Awards Presentation

11:00-11:15 am WTB 133

Scientific Sessions (There will be three concurrent sessions in rooms # WTB 133, WTB 136 and WTB 137 and four rooms on Saturday)

Friday Morning Sessions

Room# WTB 133	Session 1: Biomechanics I **Session Chair**: Peter Smith, *Limbitless Solutions* **Co-Chair:** Denis DiAngelo, *University of Tennessee Health Science Center*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
59	**8:30**	**1-2**	Novel Socket Design for Myoelectric Prostheses: Innovative Solutions for Enhanced Comfort and Fit ***Natalia Montalvo***, ***Katherine Valdes***, *Om Vishanagra, Cameron Stott, Peter Smith, John Sparkman, Albert Manero* *Limbitless Solutions*	**Natalia Montalvo, Katherine Valdes**
99	**8:45**	**1-3**	Standardizing evaluation for multi-gesture control training and usability for electromyographic prosthesis ***Abrianna Lalle***, *Jeffrey Stevenson, Delaney Gunnell, Samantha Migliore, Ethan Bell, Sophie Bennett, Pavan Senthil, Annelisa Swiersz, Viviana Rivera, Peter Smith, Matt Dombrowski, John Sparkman, Albert Manero* *Limbitless Solutions*	**Abrianna Lalle**
232	**9:00**	**1-4**	Development of a Novel Suspension System for a Military Rucksack That Reduces Repetitive Stress Injuries during Ruck Marching (Ergonomics and Prosthetic) ***M. Grossman, SA Peel, MR Paquette, DJ DiAngelo*** *University of Tennessee Health Science Center, Memphis, TN*	**Grosman M, Peel SA, Paquette MR, DiAngelo DJ**
233	**9:15**	**1-5**	Evaluation of a Dynamic Ankle Orthosis to Improve the Management of Tibial Bone Stress Injuries in Local Runners: A Proposal ***PJ Johnson, MR Paquette, DJ DiAngelo*** *University of Tennessee Health Science Center, Memphis, TN*	**Johnson PJ, Paquette MR, DiAngelo DJ**

Room# WTB 136	Session 2: Nanomedicine and Drug Delivery I **Session Chair**: Arunkumar Pitchaimani, *Vellore Institute of Technology, India* **Co-Chair:** Neethu KS, *Avinashilingam Institute for Home Sciences and Higher Education for Women, Coimbatore, Tamilnadu, India*		
Abstract Number	**Presentation Time**	**Presentation Title**	**Presenting Author**
43	**8:30**	Peptoid-conjugated gold nanorods for targeted hyperthermia of cancer stem cells *Jonghae Youn[1], Peiyuan Kang[1], Evan Chen[2], Zhenpeng Qin[1],* ***Jiyong Lee***[2] *[1]The University of Texas at Dallas, [2]The University of Texas at Tyler*	***Jiyong Lee***
88	**8:45**	Polymeric Nanoparticle Drug Delivery for Antioxidant-Mediated ROS Reduction in a Cisplatin-Induced In Vitro Ototoxicity Model *Afoma Okafor, Joshua Worsham, Atziry Andrade, Anthony Koo, Brandon Baker, Robert Newman, Eunsoo Yoo,* ***Ashley Jones*** *North Carolina Agricultural and Technical State University*	***Ashley Jones***
3	**9:00**	Maximizing liposome tumor delivery by hybridizing with tumor-derived extracellular vesicles	***Shoukath Sulthana***

		***Shoukath Sulthana**, Dinesh Shrestha, Santosh Aryal* *University of Texas at Tyler*	
24	**9:15**	Graphene-copper nanocomposite inhibits hACE-2 preventing cellular interaction of SARS-CoV coronaviruses ***Sohel Quazi**, Texas College*	***Sohel Quazi***
77	**9:30**	Formulation and characterization of CMPI nanoparticles for enhanced targeting of brain nicotinic receptors by positive allosteric modulator ***Rahma Aly**, Shoukath Sulthana, Robert Beaudoin, Ayman K. Hamouda, Santosh Aryal* *Department of Pharmaceutical Sciences and Health Outcomes, The Ben and Maytee Fisch College of Pharmacy, The University of Texas at Tyler*	***Rahma Aly***

Room# WTB 137	**Session 3: Medical Imaging** **Session Chair**: David Gordy, *University of Mississippi Medical Center* **Co-Chair:** Judy Gordy, *University of Mississippi Medical Center*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
70	8:30	3-1	Imaging Ultrasonography Potentiates Intrapleural Fibrinolysis in a Rabbit Model of Empyema. *Andrey Komissarov[1], Christian De Vera[1], Rebekah Emerine[1], Jincy Jacob[1], Sunil Christudas[1], Krishna Sarva[1], Ali Azghani[2], Maryam Ranjpour[1], Brion Frierson[3], Tao Peng[3], Shaoling Huang[3], David McPherson[3], Steven Idell[1], Melvin Klegerman[3], **Galina Florova[1]*** *[1]Department of Cellular and Molecular Biology, The UT Tyler School of Medicine, Tyler, TX* *[2]Department of Biology, The University of Texas at Tyler, TX* *[3]Department of Internal Medicine; The University of Texas Health Science Center at Houston, Houston, TX*	**Galina Florova**
125	**8:45**	**3-2**	Advancement Towards a Clinical Decision Tool: Utility of Ultrasonography to Monitor and Quantify Clot Size in a Rabbit Model of Retained Hemothorax ***Christian Jordan De Vera[1]**, Jincy Jacob[1], Krishna Sarva[1], Sunil Christudas[1], Oluwaseyi Akiode[1], Steven Idell[1], Andrey A Komissarov[1], Ali O Azghani[2], Galina Florova[1]* *[1]The University of Texas at Tyler Health Science Center* *[2]The University of Texas at Tyler*	**Christian Jordan De Vera**
42	**9:00**	**3-4**	Volumetric imaging to recapitulate cardiac microstructure and contractile function ***Yichen Ding**, University of Texas at Dallas*	**Yichen Ding**
197	**9:15**	**3-5**	Spinal Segmentation with a Hybrid Vision Transformer for the SPIDER Challenge ***Md Tareq Mahmud**, Subhajit Chakrabarty* *Louisiana State University Shreveport*	**Md Tareq Mahmud**

9:45-10:00 AM: Coffee Break Visit the Posters

Room# WTB 133	**Session 4: AI Applications for Healthcare and Environment** **Session Chair**: Subhajit Chakrabarty, *Louisiana State University, Shreveport* **Co-Chair:** Deepak Kumbhare, *Louisiana State University, Shreveport*

Abstract Number	Presentation Time	Presentation Number	Presentation Title	Presenting Author
135	10:00	4-1	SpineSegGAN: Automatic Segmentation of Lumbar Spine ***Devesh Sarda***, *Subhajit Chakrabarty, Udaysinh Rathod, Mridula Mavuri, Louisiana State University Shreveport*	**Devesh Sarda**
134	10:15	4-2	Real-Time Patient Safety System Using Deep Learning ***Udaysinh Rathod***[1], *Subhajit Chakrabarty*[1], *Devesh Sarda*[1], *Mridula Mavuri*[1], *Deepak Kumbhare*[2], *Stanley Hoang*[2], *Christian Quinones*[2], *John Wilson*[2], *Toluwanimi Atewogbola*[2] [1]*Louisiana State University Shreveport,* [2]*Louisiana State University Health Science Center Shreveport*	**Udaysinh Rathod**
181	10:30	4-3	More accurate prediction of PM 2.5 from MODIS satellite using Top-Of-Atmosphere Reflectance ***Mridula Mavuri***[1], *Subhajit Chakrabarty*[1], *Devesh Sarda*[1], *Udaysinh Rathod*[1], *Tirthankar Chakraborty*[2] [1]*Louisiana State University Shreveport,* [2]*Pacific Northwest National Laboratory*	**Mridula Mavuri**
198	10:45	4-4	Predicting Fitbit Sleep Scores with Feature Importance Insights ***Md Mashfiquer Rahman***, *Sharmin Nahar, Subhajit Chakrabarty* *Louisiana State University Shreveport*	**Md. Mashfiquer Rahman**
196	11:00	4-5	Modelling surface temperature and influenza-like illnesses using satellite data ***Ochi Jideofor***, *Subhajit Chakrabarty* *Louisiana State University Shreveport*	**Ochi Jideofor**
195	11:15	4-6	Predicting Alzheimer's Disease without using imaging data ***Ahana Sil***[1], *Subhajit Chakrabarty*[2] [1]*South Brunswick High School,* [2]*Louisiana State University Shreveport*	**Ahana Sil**

Room#	Session 5: Modeling
WTB 136	**Session Chair**: Ayman Hamouda, *University of Texas at Tyler* **Co-Chair:** Nathalia Pinheiro Menegasso, *University of Texas at Tyler*

Abstract Number	Presentation Time	Presentation Number	Presentation Title	Presenting Author
201	10:00	5-1	Optimizing Iodine-124 PET Imaging Protocol for Thyroid Cancer Ablation Using Pharmacokinetic Modeling ***Xiang Kong***, ***Anthony McGoron***. *Biomedical Engineering Department, Florida International University*	***Anthony McGoron***
162	10:15	5-3	High frequency acoustic multiple scattering analyses using boundary integral equations ***Tahsin Khajah***, *Mechanical Engineering Department, University of Texas at Tyler*	**Tahsin Khajah**
17	10:30	5-4	Modeling Temperature Effects on Nitric Oxide Dynamics and Vascular Diameter ***Bailey McCorkendale***, *Fateme Esmailie* *University of North Texas, Denton, TX*	**Bailey McCorkendale**
27	10:45	5-5	High-Fidelity 3D Transient Blood Flow Simulation in Patient-Specific Vascular Models Using an In-House CFD Solver ***Shuang Tu***, *Malik Baggett, Chao Jiang* *Jackson State University*	**Shuang Tu**

132	**11:00**	**5-6**	Pressure Analysis of Patient Specific Aortic Phantoms in a Custom Mock Circulatory Loop ***Ricardo Rodriguez***, *Fateme Esmailie* *University of North Texas*	**Ricardo Rodriguez**
171	**11:15**	**5-7**	An Unbiased Computational Analysis of CRISPR/Cas9 Off-Target Effect ***Wei Chen***, *Dyuti Islam, Dr. Urska Cvek, Marjan Trutschl* *Louisiana State University Shreveport*	**Wei Chen**

Session 6: Nanomedicine and Drug Delivery II, Room# WTB 137

Session Chair: Jayoung Kim, *University of North Texas Health Science Center*
Co-Chair: Viswanathan Sundaram, *University of Texas at Tyler*
10:00 – 10:30 AM: ***Session Keynote,*** ***Minjun Kim****, Southern Methodist University*
Title: Future of Nanomedicine: Microrobots, AI, and Nanopores for Precision Diagnostics and Therapy



Dr. MinJun Kim presently holds the Robert C. Womack Endowed Chair Professor of Engineering position at the Department of Mechanical Engineering, Southern Methodist University. He earned his B.S. and M.S. degrees in Mechanical Engineering from Yonsei University in Korea and Texas A&M University, respectively. Dr. Kim completed his Ph.D. degree in the Division of Engineering at Brown University, where he was a recipient of the prestigious Simon Ostrach Fellowship. Following his graduate studies, Dr. Kim served as a postdoctoral research fellow at the Rowland Institute at Harvard University. In 2006, he joined Drexel University as Assistant Professor and later earned a promotion to Professor of Mechanical Engineering and Mechanics. Dr. Kim has been dedicated to exploring biological transport phenomena, encompassing cellular/molecular mechanics and engineering in novel nano/microscale architectures, with the goal of advancing new types of nanobiotechology. This includes groundbreaking work in nanopore technology and nano/microrobotics. Throughout his career, Dr. Kim has garnered numerous accolades, including the National Science Foundation CAREER Award (2008), Drexel Career Development Award (2008), Human Frontier Science Program Young Investigator Award (2009), Army Research Office Young Investigator Award (2010), Alexander von Humboldt Fellowship (2011), KOFST Fellowship (2013 & 2015), International society of Bionic Engineering Outstanding Contribution Award (2013), Louis & Bessie Stein Fellowship (2008 & 2014), ISBE Fellow (2014), ASME Fellow (2014), UNESCO/Netexplo Top10 Technology Innovation Award (2016), KSEA & KOFST Engineer of the Year Award (2016), IEEE Senior Member (2017), Gerald J. Ford Research Fellowship (2018), Protégé of the Academy of Medicine, Engineering and Science of Texas (2019), Brain Pool Fellowship of the National Research Foundation of Korea (2023), AIMBE Fellow (2024), Fellow of the Royal Society of Chemistry (2024), Moody Outstanding Mentor Award (2024), and Senior Member of the National Academy of Inventors (2025).

Room# **WTB 137**	**Session 6: Nanomedicine and Drug Delivery II** **Session Chair**: Jayoung Kim, *University of North Texas Health Science Center* **Co-Chair:** Viswanathan Sundaram, *University of Texas at Tyler*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
37	**10:30**	**6-1**	Novel dual imaging nanoparticles to stimulate therapeutic angiogenesis for the treatment of peripheral arterial diseases ***Tam Nguyen***[1], *Ethan Gerhard*[2], *Bushra Afzal*[3], *Vy Tran*[1], *Priyanka Iyer*[1], *Na Nguyen*[1], *Cynthia Co*[1], *Luis Soto*[1], *Le Yu*[4], *Su Yan*[2], *Jian Yang*[5], *Ralph Mason*[3], *Kytai Nguyen*[1] [1]*The University of Texas at Arlington,* [2]*The Pennsylvania State Universityt,* [3]*UT Southwestern Medical Center,* [4]*University of Missouri-Kansas City,* [5]*Westlake University*	**Tam Nguyen**
36	**10:45**	**6-2**	Novel hybrid small-molecules and topical drug delivery strategies for treating optic neuropathy ***Suchismita Acharya***, *Charles E. Amankwa, Biddut Debnath* *University of North Texas Health Science Center*	**Suchismita Acharya**
5	**11:00**	**6-3**	Anthracene based Organo-ruthenium arene complexes as Potential Anticancer Agents: Synthesis, Characterization, Mechanistic Insights, and Prospects for Liposomal Nano Drug Delivery ***Neethu K Sankaranarayanan***[1], *Viswanathan Sundaram*[2], *Dharmaraj Nallasamy*[3] [1]*Avinashilingam Institute for Home Sciences and Higher Education for Women Coimbatore Tamilnadu India,* [2]*Department of Pharmaceutical Sciences and Health Outcomes, University of Texas at Tyler, Texas*	**Neethu K Sankaranarayanan**

			[3]*Department of Chemistry, Bharathiar University, Coimbatore, India*	
83	**11:15**	**27-2**	Nanoparticle-Based Targeted Therapy for Bone Metastases in Prostate Cancer ***Amalendu Ranjan*** *UNT Health Science Center*	**Amalendu Ranjan**

11:45-1:00: Room #WTB 133

Plenary Speaker 1 and Lunch (Friday 12th Sep, 2025)

Moderator: Dr. Rahmat Talukder, PhD. Head of the Department of Pharmaceutical Sciences and Health Outcomes, The University of Texas at Tyler

Gang Bao, PhD, Department of Bioengineering, Rice University, Houston, TX

Title: Nanomedicine and Genome Editing Approaches for Disease Therapies



Dr. Gang Bao is the Foyt Family Chair Professor in the Department of Bioengineering, Rice University. He is also the Co-Director of the Cancer Bioengineering Collaborative, a joint research center between Rice University and MD Anderson Cancer Center. Dr. Bao received his undergraduate and Master's degrees from Shandong University in China, and his PhD from Lehigh University in the US. Dr. Bao is a Fellow of the American Association of Advancement in Science (AAAS), American Institute for Medical and Biological Engineering (AIMBE), Biomedical Engineering Society (BMES), American Society of Mechanical Engineers (ASME), American Physical Society (APS), and International Academy of Medical and Biological Engineers (IAMBE).

Dr. Bao's current research is focused on the development of genome editing and nanomedicine tools and approaches for biological and disease studies, including magnetic nanoparticle based diagnosis and treatment of chronic diseases such as cancer, viral and non-viral based in vivo delivery methods, design and optimization of CRISPR/Cas9 for gene editing, and the application of gene editing for treating sickle cell disease and cystic fibrosis.

Friday Afternoon Sessions

Room# WTB 133	**Session 7: Chemical Engineering** **Session Chair**: Fernando Resende, *University of Texas at Tyler* **Co-Chair:** Shuhao Liu, *University of Texas at Tyler*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
167	**1:15**	**25-1**	Recovering Rare Earth Elements from Brine with Amino Acid-Anchored Two-Dimensional Materials ***Zishu Cao***[1], *Derick Phanos*[1], *Charles Defor*[1], *Obaid Khan*[2], *Shaowei Yang*[2] [1]*University of Texas at Tyler,* [2]*Cleveland state University*	**Zishu Cao**
103	**1:30**	**25-2**	Improved antifouling characteristics of material surfaces by applying nanomaterials and surface modifications ***Shuhao Liu*** *University of Texas at Tyler*	**Shuhao Liu**
186	**1:45**	**25-3**	Biological and Environmental Implications of Using Waste Glass Powder as Cement and Sand Replacement in Concrete ***Ebubekir Siddik Yesil***[1], *Tayfun Altuğ Soylev*[2] [1]*Civil Engineer, Istanbul Turkey,* [2]*Gebze Technical University*	**Ebubekir Siddik Yesil**
173	**2:00**	**25-4**	Thermo-Catalytic Approaches for the Conversion of Biomass into Hydrocarbons ***Fernando Resende*** *University of Texas at Tyler*	**Fernando Resende**
191	**2:15**	**25-5**	Lead-Free Ca3BiX3 (X = F, Cl, Br, And I) Halide Perovskites for Photovoltaic And Energy Harvesting Applications: A First-Principles Study ***Md Adil Hossain***, *Md Rasidul Islam, Md Masud Rana* *University of Texas at Tyler*	**Md Adil Hossain**

216	**2:30**	**25-6**	Predicting nitrogen dioxide pollutant level for three cities using satellite data ***Tahmina Akter Anondi***, *Subhajit Chakrabarty* *Louisiana State University Shreveport*	**Tahmina Akter Anondi**
221	**2:45**	**25-7**	Directed Reaction Discovery: Accessing the Remote Synthetic Landscape ***Andy Thomas-TexasTexas A &M University***	**Andy Thomas**

Session 8: Cardiovascular: Impact of Obesity, Drug Abuse, and Chemotherapy in Cardiac Health and Therapies

Session Chair: Chowdhury S. Abdullah, *The University of Texas at Tyler*
Co-Chair: Mohammad Alfrad Nobel Bhuiyan, *Louisiana State University Health Science Center at Shreveport*

1:15-145 PM, Room# WTB 136

Session Keynote: Dr. *Md Shenuarin Bhuiyan, LSU Health Shreveport*

Title: Molecular mechanisms and nano-particle drug delivery systems to combat doxorubicin cardiomyopathy



Dr. Md. Shenuarin Bhuiyan is a Professor in the Department of Pathology and Translational Pathobiology at Louisiana State University Health Sciences Center – Shreveport. He leads a nationally and internationally recognized cardiovascular research program focused on the molecular mechanisms underlying heart failure and cardiac hypertrophy. Over the past 1
2 years, Dr. Bhuiyan has maintained continuous, peer-reviewed NIH R01-level funding as Principal Investigator. His current active NIH R01 grants are centered on elucidating novel mechanisms of mitophagy and mitochondrial dysfunction in the failing heart. His laboratory employs a multidisciplinary approach that integrates molecular biology, genetics, and functional assays using genetically engineered mouse models to interrogate cardiac pathophysiology at mechanistic depth. A major emphasis of Dr. Bhuiyan's research is understanding how disruptions in mitochondrial dynamics and quality control contribute to the development and progression of cardiovascular diseases. His work has advanced the field's understanding of mitochondrial roles in cardiac remodeling and dysfunction. Dr. Bhuiyan has a distinguished record of training the next generation of scientists, including undergraduate students, graduate researchers, and postdoctoral fellows, many of whom have gone on to successful careers in academia and the biotechnology sector. He has authored more than 80 peer-reviewed publications in leading biomedical journals including The Journal of Clinical Investigation, Journal of the American College of Cardiology, Journal of Molecular and Cellular Cardiology, Hypertension, Redox Biology, and Journal of the American Heart Association. He serves on the editorial boards of Scientific Reports, Frontiers in Physiology, and the Journal of Pharmacological Sciences. Dr. Bhuiyan is a recognized leader in cardiovascular research, regularly serving as a grant reviewer for the National Institutes of Health (NIH) and the American Heart Association (AHA), further attesting to his expertise and impact in the field.

Room# WTB 136	**Session 8: Cardiovascular: Impact of Obesity, Drug Abuse, and Chemotherapy in Cardiac Health and Therapies** **Session Chair**: Chowdhury S. Abdullah, *The University of Texas at Tyler* **Co-Chair:** Mohammad Alfrad Nobel Bhuiyan, *Louisiana State University Health Science Center at Shreveport*			
Abstract Number	**Presentation Time**	8-2	**Presentation Title**	Presenting Author
62	**1:45**	**8-3**	Systemic Impacts of Methamphetamine Use: A Comprehensive Laboratory Analysis ***Mohammad Alfrad Nobel Bhuiyan*** *LSU Health Shreveport*	**Mohammad Alfrad Nobel Bhuiyan**
92	**2:00**	**8-4**	Mitochondrial Dysfunction and Maladaptive Cardiac Remodeling Associated with Methamphetamine-Induced Cardiomyopathy ***Chowdhury S Abdullah*** *The University of Texas at Tyler*	**Chowdhury S Abdullah**
31	**2:15**	**8-3**	Stratifying Therapeutic Enoxaparin Dose in Morbidly Obese Patients by BMI Class: A Retrospective Cohort Study ***Young Lee***	**Young Lee**

			University of Texas at Tyler, Ben and Maytee Fisch College of Pharmacy	
124	**2:30**	**8-4**	Decreasing heart inflammation in a diabetic mouse model with *Hippocraeta Velutina* extract ***Maricica Pacurari*** *Jackson State University*	**Maricica Pacurari**

Room# WTB 137	**Session 9: Neuroscience** **Session Chair**: Lir-Wan Fan, *University of Mississippi Medical Center* **Co-Chair:** Yi Pang, *University of Mississippi Medical Center*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
66	**1:15**	**9-1**	Microglia play essential roles in developmental myelination ***Yi Pang***[1], *Shuying Lin*[2], *Kathleen Carter*[1] [1]*Department of Pediatrics, University of Mississippi Medical Center* [2]*Department of Physical Therapy, School of Health-Related Professions, University of Mississippi Medical Center*	**Yi Pang**
144	**1:30**	**9-2**	Neonatal inflammation causes sex-specific effects on attention-deficit/hyperactivity disorder (ADHD)-like behaviors, and homeostatic responses to sleep disturbances in adolescent rats using machine learning-based analysis ***Lir-Wan Fan***[1], *Jonathan Lee*[1], *Silu Lu*[1], *Joseph Crosby*[1], *Charles Matheny*[1], *James Shaffery*[2], *Norma Ojeda*[3], *Haifeng Wang*[4], *Md Rokibul Hasan*[5], *Vignesh Nayak*[6], *Michelle Tucci*[7], *Yu-Ching Tu*[8], *Lu-Tai Tien*[9] [1]*Department of Pediatrics, Division of Newborn Medicine, University of Mississippi Medical Center, Jackson, MS 39216, USA,* [2]*Department of Psychiatry and Human Behavior, Animal Behavior Core, University of Mississippi Medical Center, Jackson, MS 39216, USA,* [3]*Department of Advanced Biomedical Education, University of Mississippi Medical Center, Jackson, MS 39216, USA,* [4]*Department of Industrial and Systems Engineering, Mississippi State University, Mississippi State, MS 39762,* [5]*Department of Data Science, University of Mississippi Medical Center, Jackson, MS 39216, USA,* [6]*Department of Pediatrics, Division of Pediatric Pulmonary, University of Mississippi Medical Center, Jackson, MS 39216, USA,* [7]*Department of Anesthesiology, University of Mississippi Medical Center, Jackson, MS 39216, USA,* [8]*Department of Long-Term Care Management, Chung Hwa University of Medical Technology, Rende Dist, Tainan City, 71703, Taiwan,* [9]*School of Medicine, Fu Jen Catholic University, Xinzhuang Dist, New Taipei City 24205, Taiwan*	**Lir-Wan Fan**
145	**1:45**	**9-3**	Intranasal insulin protects against brain injury and improves sensorimotor dysfunction following hypoxia-ischemia in P5 neonatal rats ***Madison Klim***[1], *Carolyn Glendye*[1], *Jonathan Lee*[1], *Elizabeth White*[1], *Valerie Quach*[1], *Nilesh Dankhara*[1], *Silu Lu*[1], *Shuying Lin*[2], *Norma Ojeda*[3], *Gene Bidwell III*[4], *Yi Pang*[1], *Lu-Tai Tien*[5], *Michelle Tucci*[6], *Abhay Bhatt*[1], *Lir-Wan Fan*[1] [1]*Department of Pediatrics, Division of Newborn Medicine, University of Mississippi Medical Center, Jackson, MS 39216, USA,* [2]*Department of Physical Therapy, University of Mississippi Medical Center, Jackson, MS 39216, USA,* [3]*Department of Advanced Biomedical Education, University of Mississippi Medical Center, Jackson, MS 39216, USA,* [4]*Department of*	**Madison Klim**

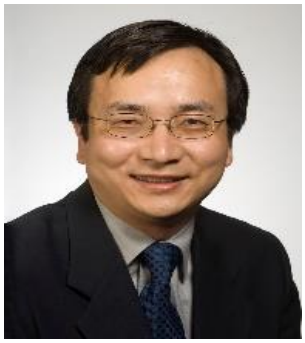
			Neurology, University of Mississippi Medical Center, Jackson, MS 39216, USA, [5]School of Medicine, Fu Jen Catholic University, Xinzhuang Dist, New Taipei City 24205, Taiwan, [6]Department of Anesthesiology, University of Mississippi Medical Center, Jackson, MS 39216, USA	
146	**2:00**	**9-4**	Neonatal lipopolysaccharide exposure enhances methamphetamine-induced alterations in the dopamine transporter and reinstated behavioral sensitization in adult rats analyzed with explainable machine learning ***Jonathan Lee***[1], *Kuo-Ching Wang*[2], *Norma Ojeda*[3], *Haifeng Wang*[4], *Han-Sun Chiang*[5], *Michelle Tucci*[6], *Han-Chi Wei*[5], *Asuka Kaizaki-Mitsumoto*[7], *Sachiko Tanaka*[8], *Nilesh Dankhara*[1], *Lu-Tai Tien*[5], *Lir-Wan Fan*[1] *[1]Department of Pediatrics, Division of Newborn Medicine, University of Mississippi Medical Center, Jackson, MS 39216, USA, [2]Department of Anesthesiology, Shin Kong Wu Ho-Su Memorial Hospital, Taipei City, Taiwan, [3]Department of Advanced Biomedical Education, University of Mississippi Medical Center, Jackson, MS 39216, USA, [4]Department of Industrial and Systems Engineering, Mississippi State University, Mississippi State, MS 39762, USA, [5]School of Medicine, Fu Jen Catholic University, Xinzhuang Dist, New Taipei City 24205, Taiwan, [6]Department of Anesthesiology, University of Mississippi Medical Center, Jackson, MS 39216, USA, [7]Department of Pharmacology, Toxicology & Therapeutics, Division of Toxicology, School of Pharmacy, Showa University, Shingawa-ku, Tokyo 142-8555, Japan, [8]Center for Research and Development in Pharmacy Education, School of Pharmacy, Nihon University, Funabashi, Chiba 274-8555, Japan*	**Jonathan Lee**
161	**2:15**	**9-5**	Innovative hydrogel composites treatment and neuronal assessment following craniofacial defects in adolescent rats ***Almia Valentine***[1], *Jonathan Lee*[2], *Chloe Batiste*[2], *Madisyn Avery*[2], *Charles Matheny*[2], *Shuying Lin*[3], *Amol Janorkar*[4], *Chipo Chapusha*[4], *William Farmer*[4], *David Gordy*[5], *Susana Salazar Marocho*[4], *Bernadette Grayson*[6], *Michelle Tucci*[7], *Lir-Wan Fan*[2] *[1]McNair HBCU Research Scholars Program, Tougaloo College, MS 39174, USA, [2]Department of Pediatrics, Division of Newborn Medicine, University of Mississippi Medical Center, Jackson, MS 39216, USA, [3]Department of Physical Therapy, University of Mississippi Medical Center, Jackson, MS 39216, USA, [4]Department of Biomedical Materials Science, University of Mississippi Medical Center, Jackson, MS 39216, USA, [5]Department of Radiology, University of Mississippi Medical Center, Jackson, MS 39216, USA, [6]Department of Population Health Science, University of Mississippi Medical Center, Jackson, MS 39216, USA, [7]Department of Anesthesiology, University of Mississippi Medical Center, Jackson, MS 39216, USA*	**Almia Valentine**
179	**2:30**	**31-2**	The Jackson Heart Study Undergraduate Training and Education Center: A 25 Year Success Story ***Wendy White***, *Kisa Harris, Amel Mohamed* *Tougaloo College*	**Wendy White**

Session 10: Neuroscience-Neuromodulation II

3:00-3:30 PM: Session Keynote, Room #WTB 137

Session Chair: Elisa Castagnola, *Louisiana Tech University*

Co-Chair: Deepak Kumbhare, *LSU Health Shreveport*



Dr. Shengnian Wang, *Louisiana Tech University*

Dr. Shengnian Wang is the Harrelson Family Professor of Chemical Engineering at Louisiana Tech University. His research interests include novel nanomaterials and their use in biomedical, pharmaceutics, clean energy and water. His research has been funded by NSF, NIH, the State of Louisiana, and private sectors. He has 63 peer-reviewed research papers including those published in Nature Comm, JACS, Phy Rew Lett, Biosensor & Bioelectron, Carbon, ACS App Mater Interface, Lab Chip, J. Power Sources, Electrochimica Acta, Applied Catalysis B, J Catal, Chem Eng J, and J. Hazardous Materials. He is an active member of ACS, AIChE, BMES, MRS, and AAAS.

2:45-3:00 PM: Coffee Break and Visit Posters

Room# WTB 137	**Session 10: Neuroscience-Neuromodulation II** Session Chair: Elisa Castagnola, Louisiana Tech University Co-Chair: Deepak Kumbhare, LSU Health Shreveport			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
127	**3:00**	**Keynote**	MXene/MOF Composite Electrochemical Sensor for Dopamine Detection *Sara Dehdashtian, Yan Deng, Yixin Liao, Teresa A Murray, **Shengnian Wang*** *Louisiana Tech University*	**Shengnian Wang**
126	**3:30**	**10-1**	Enhanced Neurochemical Detection Using MXene/PEDOT-Coated Flexible Glassy Carbon Microelectrode Arrays ***Ilaria Gatti**[1], Karamullah Eisawi[2], Michael Naguib[2], Elisa Castagnola Castagnola[1]* *[1]Louisiana Tech University* *[2]Tulane University*	**Ilaria Gatti**
119	**3:45**	**10-2**	Neuroprotective Efficacy of Minocycline Therapy in Experimental Moderate Traumatic Brain Injury ***Geetika Sruti Vutukuri Amarnath**[1], Ritika Roy[1], Pragya Dhungel[1], Yashwanthi Yanamadala[1], Afrika Williams[1], Claire Jones[1], Xiao-Hong Lu[2], Teresa Murray[1]* *[1]Louisiana Tech University* *[2]Louisiana State University Health Sciences Center-Shreveport*	**Geetika Sruti Vutukuri Amarnath**
26	**4:00**	**10-3**	The role of astrocytes in active and silent synapse formation ***Isabella Farhy-Tselnicker*** *Texas A&M University*	**Isabella Farhy-Tselnicker**
69	**4:15**	**10-4**	Brain Organoid Intelligence: Anticipatory Ethics, Categorical Errors, and a Danger Zone for Neuroscience ***Michael Nestor**, Richard Wilson* *The National Academies of Science, Engineering, and Medicine*	**Michael Nestor**

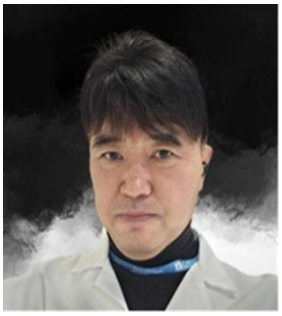
Session 11: Nanomedicine and Drug Delivery-III

Session Chair: Dustin Patterson, *University of Texas at Tyler*
Co-Chair: Eunsoo Yoo, *North Carolina A&T State University*

3:15-3:45 pm: Session Keynote, Dr. Dongki Kim, *ExoTop Theragnostics Inc.*

Room #WTB 133

Title: Exosomes as Precision Tools for the Next Era of Regenerative and Diagnostic Medicine" (Subtitle: From Neurological Repair to Liquid Biopsy - A Translational Journey



Dr. Dongki Kim is a stem cell biologist and biotechnology entrepreneur specializing in the development of exosome-based diagnostics and therapeutics. He is the CEO and Co-Founder of ExoTop Theragnostics Inc., headquartered in College Station, Texas. Dr. Kim earned his Ph.D. in Biomedical Science from Tokyo Institute of Technology and completed his postdoctoral and research faculty training at the Texas A&M Institute for Regenerative Medicine, where he worked under the mentorship of Dr. Darwin J. Prockop, one of the foremost authorities in adult stem cell biology.

Over the past decade, Dr. Kim's research has focused on mesenchymal stromal cell-derived extracellular vesicles for treating inflammation, neurological disorders, and autoimmune conditions. His scientific contributions appear in journals such as PNAS, Stem Cell Reports, and FASEB J. At ExoTop, he directs the development of urine-based diagnostic kits for urologic cancers and nano-vesicle platforms for precision drug delivery. Dr. Kim's translational expertise bridges basic science with clinical applications, positioning ExoTop as a leading innovator in exosome-enabled regenerative medicine and personalized healthcare.

Room# WTB 133	**Session 11: Nanomedicine and Drug Delivery-III** **Session Chair**: Dustin Patterson, *University of Texas at Tyler* **Co-Chair:** Eunsoo Yoo, *North Carolina A&T State University*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
14	**3:45**	**11-1**	Oxygen Sensitive Drug Release Using Hemoglobin Microbubbles: A New Approach to Targeting Hypoxia in Ultrasound-Mediated Drug Delivery ***Ghazal Rastegar***, *Mohammad Salman, Shashank Sirsi* *University of Texas at Dallas*	**Ghazal Rastegar**
1	**4:00**	**11-2**	Reengineered Immunovesicles in Drug Delivery ***Viswanathan Sundaram***, *Santosh Aryal* *University of Texas at Tyler*	**Viswanathan Sundaram**
82	**4:15**	**11-3**	Long-Acting Drug Delivery from Core-Shell Microparticles Offering Pre-Programmed and Customizable Release Kinetics ***Heather (Chia-Chien) Hsu***[1], *Katherine Chen*[2], *Haonan Huo*[3], *Tyler Graf*[2], *Alyssa Kunkel*[2], *Kevin McHugh*[1, 2] [1]*Department of Chemistry, Rice University, Houston, TX, USA,* [2]*Department of Bioengineering, Rice University, Houston, TX, USA,* [3]*Institute of Chemistry, Chinese Academy of Sciences, China*	**Heather (Chia-Chien) Hsu**
11	**4:30**	**11-4**	Exploration of the Anti-cancer properties of gold nanoparticles biosynthesized using Vitis vinifera seeds and Aegle marmelos fruits extracts ***Narendhirakannan R.T*** *Department of Biochemistry, Kongunadu Arts and Science College, G.N. Mills (PO), Coimbatore, Tamil Nadu, India*	**Narendhirakannan R.T**
2	**4:45**	**11-5**	Versatility of Extracellular Vesicles in Biomedical Applications ***Arunkumar Pitchaimani*** *Vellore Institute of Technology, India*	**Arunkumar Pitchaimani**
166	**5:00**	**11-6**	Electrospun Core-Shell Microfibers for Controlled Drug Delivery and Cellular Activities *Diala Bani Mustafa, Carla Lacerda, Shih-Feng Chou* *The University of Texas at Tyler*	**Shih-Feng Chou**

41st SOUTHERN BIOMEDICAL ENGINEERING CONFERENCE

Session 12: Targeting cell signaling in chronic diseases

Session Chair: Zakaria Abd Elmageed, *Edward Via College of Osteopathic Medicine (VCOM)*
Co-Chair: Shaimaa Gad, *Loyola University Chicago*

3:00-3:30 pm: Session Keynote, Dr. Bilal Hafeez

Title: Targeting Ribosome Biogenesis in Cancer Therapy



Dr. Hafeez is an Assistant Professor in the department of Medicine and Oncology at the University of Texas Rio Grande Valley School of Medicine and has a broad background in cancer biology, molecular therapeutics, and molecular biology with specific expertise in generating various pre-clinical mouse models of solid tumors. He has also generated various mouse models (orthotopic, xenograft, conditional Pten-knockout and transgenic) of prostate cancer. Currently, his lab research is dedicated to understanding the molecular mechanisms of ribosome biogenesis dysregulation in solid tumors and how targeting ribosome biogenesis by RNA polymerase inhibitor can suppress the growth of advanced pancreatic cancer. Dr. Hafeez serves both PI and Co-I on multiple NIH-funded grants and has published more than 70 high-impact cancer research articles in peer-reviewed journals.

Room# WTB 136	**Session 12: Targeting cell signaling in chronic diseases** **Session Chair**: Zakaria Abd Elmageed, *Edward Via College of Osteopathic Medicine* **Co-Chair:** Shaimaa Gad, *Loyola University Chicago*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
140	3:00	Keynote	Targeting Ribosome Biogenesis in Cancer Therapy ***Bilal Hafeez***, *Mudassier Ahmad, Sahir Alvi, Alfia Bilal, The University of Texas Rio Grande Valley*	**Bilal Hafeez**
96	**3:30**	**12-1**	Harnessing Lichen Acids for Targeting Triple-Negative Breast Cancer ***Hassan Ebrahim*** *Department of Biomedical Sciences, Edward Via College of Osteopathic Medicine, Monroe*	**Hassan Ebrahim**
214	**3:45**	**12-6**	AI-Guided Discovery of Brain-Penetrant Dual HER2/VEGFR2 Inhibitors for Targeted Therapy of Breast Cancer Brain Metastases ***Hamed Ali***, *Mostafa M. A. Aref, Eneye Ajayi, Md Emran Hossain* *Department of Pharmaceutical Sciences, Irma Lerma Rangel College of Pharmacy, Texas A&M University, College Station, TX*	**Hamed Alyismail**
25	**4:00**	**12-3**	Toxicity and Inflammatory Response of Cannabidiol (CBD) in Lung Epithelial Cells ***Nathalia Pinheiro Menegasso***, *Amal Ehab Al-Shweiky, Robert Beaudoin, Ayman Hamouda* *The University of Texas at Tyler*	**Nathalia Pinheiro Menegasso**
180	**4:15**	**12-4**	Understanding pathological valvular degeneration in bicuspid aortic valves ***Carla Lacerda*** *The University of Texas at Tyler*	**Carla Lacerda**
241	**4:30**	**12-5**	*Nicotinic Receptors in Respiratory Diseases: Insight from Experimental Models* ***Carla Maximo Prado***, *Nathhalia Montouro Menegasso, Ayman Hamouda* *[1]Universidade Federal de São Paulo, [2]University of Texas at Ty;er, Tyler, TX*	**Carla Prado**
15	**4:45**	**12-2**	Repurposing Atypical Antipsychotics for Aggressive Prostate Cancer Treatment: Investigating Their Role in Cell Proliferation, Migration, and ER Stress, ***Grace Lee*** *Department of Biomedical Science, Discipline of Pharmacology, Edward Via College of Osteopathic Medicine, Monroe*	**Grace Lee**

4:30-6:00: Poster Session [Authors must be at their posters]

Room #: WTB Atrium

Chair: Ibrahim Farah

Co-Chairs: Michelle Tucci, Jamil Ibrahim, Santosh Aryal, May Abdelaziz, Ayman Hamouda

Notes: Posters will be displayed until Saturday at 5:00 PM to allow judges to complete evaluations (do not remove posters)

Abstract Number	Presentation Time	Poster Number	Presentation Title	Presenting Author
217	4:30-6:00	1.	Substituted piperidines (α4)3(β2)2 nicotinic acetylcholine receptor positive allosteric modulators: In vitro pharmacology.	Sanchez
208	4:30-6:00	2.	Advancing Osteoarthritis Pain Treatment with Salvianolic Acid Derivatives *Ana Rivera, Hope Sabella, Farah Deba* *Department of Pharmaceutical Sciences and Health Outcomes. Fisch College of Pharmacy*	Ana Rivera, Hope Sabella
206	4:30-6:00	3.	Integrating biomedical innovation and reproductive health education: a hydrogel-centered intervention for aspiring healthcare professionals *Joe Wolters[1], Wesley Jameson[2], Elaine Brown[3], Oluwateniola Adepoju[4]* *[1]University of South Florida, Tampa [2]School of Medicine, Louisiana State University Health Sciences Center Shreveport* *[3]Department of Emergency Medicine, Louisiana State University Health Sciences Center, [4]Grambling State University, Louisiana*	Oluwateniola Adepoju
199	4:30-6:00	4.	MedQ: An AI-Driven Queuing System for Optimized Patient Flow *Sharmin Nahar, Dyuti Islam, Md Mashfiquer Rahman, Subhajit Chakrabarty* *Louisiana State University Shreveport*	Sharmin Nahar
172	4:30-6:00	5.	Bridging the Gap: Enhancing Medical Student Understanding of EEG Through Interactive, Technology-Driven Modules *Andrew Schwartz, Wes Jameson, Bailey Lupo, Christian Quinones* *LSU Health Shreveport*	Andrew Schwartz
169	4:30-6:00	6.	State-Level Inequities and Regional Variation in Neuraxial Pain Management During Labor in the United States *Dyuti Islam, Wei Chen, Dr. Urska Cvek, Dr. Marjan Trutschl, Dr. Qingsong Zhao* *Louisiana State University Shreveport*	Dyuti Islam
168	4:30-6:00	7.	Developing and Evaluating a Pilot Augmented Intelligence Foundations Curriculum for Medical Students *Wesley Jameson, Bailey Lupo, Andrew Schwartz, Christian Quinones, Stanley Hoang, Deepak Kumbhare* *Department of Neurosurgery, Louisiana State University Health Sciences Center, Shreveport*	Wesley Jameson
165	4:30-6:00	8.	TREM-1: An Amplifier of Pleural Inflammation in a Rabbit Model of Empyema *Jincy Jacob[1], Christian Jordan De Vera[1], Krishna Sarva[1], Ali Azghani[2], Sunil Christudas[1], Alexander Sigalov[3], Galina Florova[1], Andrey Komissarov[1]* *[1]The Department of Cellular and Molecular Biology, UT School of Medicine, Tyler,TX* *[2]The department of Biology, University of Texas, Tyler, TX* *[3]SignaBlok,Inc., Shrewsbury, MA, United States.*	Jincy Jacob
164	4:30-6:00	9.	Substituted piperidines (α4)3(β2)2 nicotinic acetylcholine receptor positive allosteric modulators: In-vivo pharmacology *Kwadwo Appiah-Poku[1], Nathalia Pinheiro Menegasso[1], Wilder Felix[2], Yushe Nazrul Islam[1],*	Kwadwo Appiah-Poku

			Adiam Michael[1], Nolawit Tilahun[1], Ganesh Thakur[2], Ayman Hamouda[1], Brent Bill[1] *[1]University of Texas at Tyler [2]Northeastern University*	
147	**4:30-6:00**	**10.**	Microglial suppressor azithromycin protects against neonatal systemic lipopolysaccharide-induced brain inflammation and pre-social interaction impairments in neonatal rats ***Yu-Ching Tu[1]**, Jonathan Lee[2], Jenna Hart[2], Madison Klim[2], Md Rokibul Hasan[3], Michelle Tucci[4], Norma Ojeda[5], Yi Pang[2], Lu-Tai Tien[6], Lir-Wan Fan[2]* *[1]Department of Long-Term Care Management, Chung Hwa University of Medical Technology, Rende Dist, Tainan City, 71703, Taiwan* *[2]Department of Pediatrics, Division of Newborn Medicine, University of Mississippi Medical Center, Jackson, MS 39216, USA* *[3]Department of Data Science, University of Mississippi Medical Center, Jackson, MS 39216, USA* *[4]Department of Anesthesiology, University of Mississippi Medical Center, Jackson, MS 39216, USA [5]Department of Advanced Biomedical Education, University of Mississippi Medical Center, Jackson, MS 39216, USA* *[6]School of Medicine, Fu Jen Catholic University, Xinzhuang Dist, New Taipei City 24205, Taiwan*	**Yu-Ching Tu**
131	**4:30-6:00**	**11.**	Maternal poly (I:C) exposure disrupts cerebral cortical and hippocampal neurogenesis in the offspring mice ***Catherine Zhou[1]**, Kathleen Carter[2], Lir-Wan Fan[2], Abhay Bhatt[2], Yi Pang[2]* *[1]SURE program, University of Mississippi Medical Center* *[2]Department of Pediatrics, University of Mississippi Medical Center*	**Catherine Zhou**
118	**4:30-6:00**	**12.**	Evaluating Quality Control Metrics in Microparticle Formulation for Sustained Drug Release ***Atharva Markale*** *Staff*	**Atharva Markale**
110	**4:30-6:00**	**13.**	Can erythrocyte permeability alter airway nitric oxide levels? *Manoj Pandit, **Steven Jones*** *Louisiana Tech University*	**Steven Jones**
104	**4:30-6:00**	**14.**	Regulation of interleukin-8 (IL-8) gene expression by bacterial extracellular vesicles isolated from organic dust in the human HMC3 microglial cell line ***Velmurugan Meganathan**, Venkata Devabakthuni, Shilpa Kusampudi, Vijay Boggaram* *University of Texas at Tyler School of Medicine*	**Velmurugan Meganathan**
101	**4:30-6:00**	**15.**	Targeting CD44 Receptors in the Lungs by Liposomes Enhances Host Immunity Against Tuberculosis ***Eric Chau[1]**, Vipul Singh[2], Abhishek Mishra[2], Anjana Tiwari[1], Chinnaswamy Jagannath[2], Arshad Khan[2], Biana Godin[1]* *[1]Department of Nanomedicine, Houston Methodist Research Institute [2]Department of Pathology and Genomic Medicine, Houston Methodist Research Institute*	**Eric Chau**

91	**4:30-6:00**	**16.**	Gamified EMG Training for Prosthesis Control: Impact of Multiplayer Modes on Enjoyment and Social Engagement ***Sophie Bennett*, *Joaquin Royer*, *Maanya Pradeep*, *Pavan Senthil, Delaney Gunnell, Abrianna Lalle[1], Ethan Bell, Peter Smith, Matt Dombrowski, John Sparkman, Albert Manero*** *Limbitless Solutions*	**Sophie Bennett, Joaquin Royer, Maanya Pradeep**
58	**4:30-6:00**	**17.**	COPPER-BASED BIODEGRADABLE PHOTOLUMINESCENT NANOPARTICLES FOR IMAGING AND DRUG DELIVERY *Ingrid Guerrero-Rodriguez[1], **Luis Soto-Garcia**[1], Bushra Afzal[2], Ethan Gerhard[3], Akhila Sonti[4], Yu Le[5], Chau Nguyen[1], Luis Dibert[1], Na Nguyen[1], Su Yan[3], Ralph Mason[2], Li Liu[2], Jian Yang[6], Tam Nguyen[1], Kytai Nguyen[1]* *[1]The University of Texas at Arlington [2]University of Texas Southwestern Medical Center* *[3]Pennsylvania State University* *[4]Texas Christian University* *[5]University of Missouri-Kansas City [6]Westlake University*	**Luis Soto-Garcia**
57	**4:30-6:00**	**18.**	Antimicrobial and Fire-Retardant Coatings for Soft Surfaces in Hospitals *Brinkley Vaughn[1, 2], Evan Bauch[1, 2], Ambry Lofton[1, 3], Quoc-Nghia N. Duong[1], Joyjit Ghosh[1], **Vladimir Reukov**[1]* *[1]Department of Textiles, Merchandising, and Interiors, University of Georgia, Athens, Ga, United States* *[2]School of Chemical, Materials, and Biomedical Engineering, University of Georgia, Athens, Ga, United States [3]Franklin College of Arts and Sciences, University of Georgia, Athens, Ga, United States*	**Vladimir Reukov**
52	**4:30-6:00**	**19.**	Targeting Bromodomain-Containing Protein 4 in Abdominal Aortic Aneurysm *Javier Lopez, Yunzhuan Hou, Oluwaseun Adeyanju, Guoqing Qian, Xia Guo* *University of Texas Health Science Center at Tyler*	**Javier Lopez**
51	**4:30-6:00**	**20.**	DOCK2 mediates macrophage oxidative stress in obesity associated lung injury ***Ashoka Kumar*, *Sai Boddu, Yunzhuan Hou, Oluwaseun Adeyanju, Xia Guo, Guoqing Qian*** *UT Tyler Health Science Center*	**Ashoka Kumar**
48	**4:30-6:00**	**21.**	Investigating Methods for Small Molecule Polymerization inside the HK97 Virus-Like Particle ***Cailey Rocquemore*, *Alexis Osborn, Dustin Patterson*** *The University of Texas at Tyler*	**Cailey Rocquemore**
47	**4:30-6:00**	**22.**	Virus-like particles as targeted drug delivery nanocarriers for triple-negative breast cancer ***Ricky Zhu*, *Ruihang Deng, Maria Quintero, Caden Black, Madison Adams, Dustin Patterson, Jiyong Lee*** *The University of Texas at Tyler*	**Ricky Zhu**
45	**4:30-6:00**	**23.**	Polypeptide-Based Functionalization of Quartz Crystal Microbalance Sensors: Advancing Analytical Sensitivity and Selectivity ***Olivia Bridges*[1, 2], *Samantha Sullivan[3], Sheetal Chowdhury[1], Charles Laber[4], Austin Scircle[4], Amol Janorkar[1], Jared Cobb[4]*** *[1]University of Mississippi Medical Center*	**Olivia Bridges**

			[2]Oakridge Institute for Science and Education *[3]Old Dominion University* *[4]US Army Corps of Engineers, Engineer Research and Development Center*	
41	**4:30-6:00**	**24.**	Resolution Enhancement by Subpixel Sampling and Computational Registration and Reconstruction ***Jonathan Brewer**, Milad Almasian, Alireza Saberigarakani, Xinyuan Zhang, Fenghua Shi, Yichen Ding* *The University of Texas at Dallas*	**Jonathan Brewer**
40	**4:30-6:00**	**25.**	Exploring Zebrafish Heart Contraction with Light Field Microscopy ***Alireza Saberigarakani**[1], Riya P. Patel[1], Milad Almasian[1], Xinyuan Zhang[1], Jonathan Brewer[1], Jichen Chai[1], Kelli Carroll[2], Yichen Ding[1]* *[1]University of Texas at Dallas* *[2]Wofford College*	**Alireza Saberigarakani**
35	**4:30-6:00**	**26.**	Role of KIF4A in FXa induced myofibroblast differentiation of human pleural mesothelial cells ***Sudishna Khanal**, Mitsuo Ikebe* *Department of Cellular and Molecular Biology, University of Texas at Tyler Health Science Center*	**Sudishna Khanal**
32	**4:30-6:00**	**27.**	Real-Time Varroa Mite Detection in Honeybees Using Lightweight Image Classification Models on Edge Devices ***Qingsong Zhao**, Kevin Zhao, Louis Echfu, Subhajit Chakrabarty* *LSU Shreveport, [2]Caddo Parish Magnet High School*	**Qingsong Zhao**
12	**4:30-6:00**	**28.**	Simultaneous Detection of Vibrio parahaemolyticus tdh and trh Genes in Oysters Using Multienzyme Isothermal Rapid Amplification Coupled with Lateral Flow Dipstick Assay ***Seongbin Park**, Yan Zhang* *Mississippi State University*	**Seongbin Park**
10	**4:30-6:00**	**29.**	Influence of surface PEG coating in liposomal drug delivery system ***Troy Dane**, Israel Joshua Santhosh, Viswanathan Sundaram, Santosh Aryal* *Department of Pharmaceutical Sciences and Health Outcomes, Ben and Maytee Fisch College of Pharmacy, University of Texas at Tyler, Tyler*	**Troy Dane**
9	**4:30-6:00**	**30.**	Enhancing drug delivery via Reengineered Cell-Based Drug Delivery Systems ***Israel Joshua Santhosh**, Macie Kirby, Viswanathan Sundaram, Dinesh Shrestha, Shoukath Sulthana, Santosh Aryal* *Department of Pharmaceutical Sciences and Health Outcomes, Ben and Maytee Fisch College of Pharmacy, University of Texas at Tyler, Tyler*	**Israel Joshua Santhosh**
8	**4:30-6:00**	**31.**	Macrophage-derived exosomes coating on gold nanorods for photothermal therapy ***Anavya Jernigan**, Shoukath Sulthana, Viswanathan Sundaram, Santosh Aryal* *Department of Pharmaceutical Sciences and Health Outcomes, Ben and Maytee Fisch College of Pharmacy, University of Texas at Tyler, Tyler*	**Anavya Jernigan**
7	**4:30-6:00**	**32.**	Enhanced tumor delivery of nanoparticles by coupling with natural killer cell derived extracellular vesicular ***Alisha Upreti**, Viswanathan Sundaram, Sriyam Joshi, Santosh Aryal*	**Alisha Upreti**

			Department of Pharmaceutical Sciences and Health Outcomes, Ben and Maytee Fisch College of Pharmacy, University of Texas at Tyler, Tyler	
60	**4:30-6:00**	**33.**	Androgen-induced High Blood Pressure and Lymphocytes Intracellular Trafficking in Polycystic Ovary Syndrome ***Myla Smith***, *Peighton Powe, Mohadetheh Moulana* *Jackson State University*	**Myla Smith**
102	**4:30-6:00**	**34.**	Time-Resolved Raman Spectroscopy with Gated Detection for Analysis of Biological Tissues ***Fang Chen***, *Shan Yang* *Jackson State University*	**Fang Chen**
230	**4:30-6:00**	**35.**	Exploring the Therapeutic Potential of Fibroblast-Derived EVs in In Vitro Wound Healing Models ***Madeleine Harris***, *Viswanathan Sundaram, Santosh Aryal* *The University of Texas at Tyler*	**Madeleine Harris**
220	**4:30-6:00**	**36.**	Cell-Penetrating Peptide, 30Kc19α: A Platform for Targeted Therapeutic Delivery ***Jiyeon Hong***, *Nathaniel Suk-Yeon Hwang* *Seoul National University, Republic of Korea*	**Jiyeon Hong**
222	**4:30-6:00**	**37.**	Developing a Novel Succinct Synthetic Approach to the Modification of Alginate for Use in Biomedical Applications ***Hope Murphy-McDaniel***[1], *Sharon Hamilton*[2] [1]UT Health Houston McGovern Medical School, [2]Ouachita Baptist University	**Hope Murphy-McDaniel**
223	**4:30-6:00**	**38.**	Developing Modern Polymeric Materials for Biomedical Applications ***Sharon Hamilton*** *Ouachita Baptist University*	**Sharon Hamilton**
224	**4:30-6:00**	**39.**	Advancing Wound Healing: Exploring Electrospun Fibers and Cell Culture Dynamics ***Baylee Mabry***, *Sharon Hamilto* *Ouachita Baptist University*	**Baylee Mabry**
225	**4:30-6:00**	**40.**	Analysis of thrombin release from natural polymer-based nanofibers towards the development of bioactive wound dressings ***Gracie Moore***, *Sharon Hamilton* *Ouachita Baptist University*	**Gracie Moore**
226	**4:30-6:00**	**41.**	Electrical and Electrochemical Evaluation of Glassy Carbon and CNT-Reinforced Glassy Carbon for Neural Interfaces ***Bicky Jaiswal***, *Umisha Siwakoti, Ashok Sigdel, Sarah Sellen, Sandra Zivanovic, Elisa Castagnola*	**Bicky Jaiswal**
237	**4:30-6:00**	**42.**	Chest Ultrasonography as a Tool for Measurement of Pleural Effusion: A Preclinical Study of Empyema in Rabbits ***E.V. Bailey***, *C.J. De Vera, J. Jacob, K. Sarva, S. Christudas, O. Akiode, A.A. Komissarov, A.O. Azghani, S. Idell and G. Florova* *The University of Texas at Tyler*	**E.V. Bailey**
218	**4:30-6:00**	**43.**	Structural and Interface Characterization of Biodegradable Lattices for Spinal Fusion Applications	**Evan Dong**

			Evan Dong[1], Al Ogden[2], Giovanni Solitro[2] *[1]Caddo Magnet High School, Shreveport LA,* *[2]Louisiana State University Health-Shreveport, LA*	

4:30-6:30: Workshop-1 , Room #: WTB 137

Chair: Hamed Ali, PhD, Texas A&M College of Pharmacy
Cochair: Eneye Ajayi, Texas A&M University, College of Pharmacy

Theme: ***"From Atoms to Algorithms: Medicinal Chemistry and CADD for Next-Gen Therapeutics"***

Overview

This workshop combines medicinal chemistry fundamentals with computer-aided drug design (CADD) to accelerate modern therapeutic discovery. Through focused lectures and hands-on exercises, participants will master structure-based and ligand-based approaches, applying tools such as molecular docking, dynamics simulations, and virtual screening. By the end, attendees will be equipped to model and optimize protein-ligand systems to identify promising drug candidates.

Objectives

At the end of this workshop, participants will:

- Gain the fundamental principles and applications of computer-aided drug design (CADD) in modern drug discovery.
- Differentiate between structure-based drug design (SBDD) and ligand-based drug design (LBDD) approaches.
- Explore the core concepts of molecular docking, molecular dynamics simulations, and virtual screening.
- Engage with a self-paced tutorial offering step-by-step guidance on performing docking, dynamics simulations, and screening workflows.

Learning outcomes

Upon completion, participants will be able to:

- Explain the distinctions and complementary roles of SBDD and LBDD in drug discovery.
- Prepare protein and ligand structures for computational modeling, docking, and virtual screening.
- Execute molecular docking using Glide and interpret binding poses and scoring metrics.
- Conduct molecular dynamics simulations using Desmond, and analyze key outputs such as RMSD, RMSF, and hydrogen bond interactions.
- Design a basic case study of drug discovery workflow, from target selection to hit identification.
- Perform virtual screening on compound libraries to identify promising lead candidates.

End of Friday Scientific Sessions (Explore Tyler on your own)

7:30-10:00 Program Committee Meeting (Invited members only)
Room #: UC Ball Room



Saturday

September 13, 2025

Saturday, September 13, 2025

7:00 am-5:00 pm Registration

Scientific Sessions (Rooms: WTB 133,136,137, and 234)

Room# 133	**Session 13: Innovative Polymeric Biomaterials** **Session Chair**: Urara Hasegawa, *The Pennsylvania State University* **Co-Chair:** André J. van der Vlies, *The Pennsylvania State University*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
76	**7:30**	**13-2**	Development and Application of Elastin-Inspired Self-Assembling Designer Polypeptides ***Ayae Sugawara-Narutaki*** *Institute of Science Tokyo, Japan*	**Ayae Sugawara-Narutaki**
129	**7:45**	**13-3**	Polymeric thiophene for detecting mild traumatic brain injury-specific microRNAs ***Andre J van der Vlies***[1], *Pranay Saha*[1], *Teresa Aditya*[1], *Ketan Dighe*[1], *Steven Hicks*[2], *Dipanjan Pan*[1] [1]*The Pennsylvania State University,* [2]*Penn State Health Children's Hospital*	**André J. van der Vlies**
120	**8:00**	**13-3**	ICAM-1-Targeted Antibody-Nanocarrier System for Selective Delivery to Ischemic Muscles: A Biodistribution Study in PAD Vy Tran, Na Nguyen, Savannah Le, Priyanka Iyer, Kytai Nguyen, George Alexandrakis, Tam Nguyen University of Texas at Arlington	**Vy Tran**
139	**8:15**	**13-4**	Polymeric micelles for controlled delivery of reactive sulfur species ***Urara Hasegawa*** *Pennsylvania State University*	**Urara Hasegawa**
87	**8:30**	**13-5**	Synthesis and Characterization of Degradable Polymeric Microparticles for Drug Delivery ***Chipo Chapusha***[1], *Nicholas McGowan*[1], *Anthony Haisley*[1], *Jared Cobb*[2], *Amol Janorkar*[1] [1]*University of Mississippi Medical Center,* [2]*U.S. Army Engineer Research and Development Center*	**Chipo Chapusha**
46	**8:45**	**13-6**	Ionic Liquid-Coated Nanoparticles for CNS Delivery of Antiretroviral Therapy in HIV ***Duoyi Hu***, *Christine Hamadani, Fakhri Mahdi, Priyavrat Vashisth, Ivani Jayalath, Vignesh Sundaresan, Jason Paris, Eden Tanner* *University of Mississippi*	**Duoyi Hu**
128	**9:00**	**13-7**	Discrete Brush Polymers Enhance 19F MRI Performance through Architectural Precision ***Jimmy Lawrence*** *Louisiana State University*	**Jimmy Lawrence**



Room# 136	**Session 14: Electrophysiology and Neuromodulation** **Session Chair**: Deepak Kumbhare, *LSU Health Shreveport* **Co-Chair:** Elisa Castagnola, *Louisiana Tech University*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
123	**7:30**	**14-1**	Using Stereo-EEG to Characterize Musicogenic Neural Entrainment in Humans ***Luke Landry***[1], *Roohi Katyal*[1], *mostafa hotait*[1], *Jamie Toms*[1], *Bharat Guthikonda*[1], *Deepak kumbhare*[1], *Alena Stevens*[2] [1] *LSU Health Shreveport,* [2]*Ochsner*	**Luke Landry**
75	**7:45**	**14-2**	Psychedelic Neuromodulation in Addiction: Linking Behavior, Genes, and Brain Activity ***Bo Wood***[1, 2], *Nicholas McComb*[1], *Greyson Jadwin*[3], *Deepak Kumbhare*[2, 3], *Kevin Murnane*[1, 2, 4] [1]*Department of Pharmacology, Toxicology, and Neuroscience, LSU Health Shreveport, Shreveport, Louisiana, USA,* [2]*Louisiana Addiction Research Center, Shreveport, Louisiana, USA,* [3]*Department of Neurosurgery, LSU Health Shreveport, Shreveport, Louisiana, US,* [4]*Department of Psychiatry and Behavioral Medicine, LSU Health Shreveport, Shreveport*	**Bo Wood**
64	**8:00**	**14-3**	Characterization of Microelectrode Recordings Collected During Deep Brain Stimulation Surgeries *Deepak Kumbhare*[1], *Jamie Toms*[1], *Kathryn Holloway*[2], *Mark Baron*[3], *Nicholas McComb*[4], *James Bridges*[1] [1]*LSU Health Science Center Shreveport Department of Neurosurgery,* [2]*Medical College of Virginia Department of Neurosurgery,* [3]*Medical College of Virginia Department of Neurology,* [4]*LSU Health Science Center Shreveport*	**Nicholas McComb**
38	**8:15**	**14-4**	Analyzing Intraoperative Neuromonitoring Signals Using Advanced Signal Processing and Machine Learning *Christian Quinones, John Wilson Jr., Toluwanimi Atewogbola*[1], *Bharat Guthikonda, Stanley Hoang, Deepak Kumbhare* *Louisiana State University Shreveport*	**Christian Quinones**
63	**8:30**	**14-5**	Quantitative electroenchephalography (QEEG) analysis of patients with deep brain stimulation implants. *Ian Angel* *LSU Health Shreveport (LSUHS)*	**Ian Angel**
142	**8:45**	**14-6**	Neuromodulation of the Basal Nucleus of Meynert: Unraveling the effect of Stimulation Patterns and Cognitive States *Deepak Kumbhare*[1], *Greyson Jadwin*[2] [1]*Principal Investigator, LSU Health Science Center Shreveport Department of Neurosurgery,* [2]*Research Associate, LSU Health Science Center Shreveport Department of Neurosurgery*	**Greyson Jadwin**



Room# 137	Session 15: Ethical Issues in Biomedical Engineering & Dentistry **Session Chair**: Subrata Saha, *School of Dentistry, University of Washington, Seattle, and The Department of Biomedical Engineering, University of Houston.* **Co-Chair:** Ram Vaderhobli, *University of California at San Francisco*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
190	**7:45**	**15-3**	Navigating Ethical Challenges in Bioengineering Research ***Lillion Hamil***[1], *Kenneth R. Butler*[2], *Gary L. Hami*[1, 2] [1]*Belhaven University,* [2]*University of Mississippi Medical Center*	**Lillion Hamil**
219	**8:00**	**15-4**	Can AI replace a medical doctor? Perspectives of a physician-scientist AI trainer ***Fred Xavier***, *Texas Christian University*	**Fred Xavier**
72	**8:15**	**15-5**	3D Printed Skin and Artificial Intelligence: An Anticipatory Ethical Analysis ***Ian Holmes***, *Richard Wilson* *Towson University*	**Ian Holmes**
106	**8:30**	**15-6**	3D Printing in Legal Pathophysiology: Applications in Criminal, Personal Injury, and Malpractice Cases ***Kiley Pulliam***[1], *Tiffany Siharath*[2], *Patrick Davis*[3], *Joe Landreneau*[4], *Steve Alexander*[1] [1]*LSUHS,* [2]*LSUS,* [3]*Loyola College Prep,* [4]*Landreneau Law LLC*	**Kiley Pulliam**

Session 16: "From Atoms to Algorithms: Medicinal Chemistry and CADD for Next-Gen Therapeutics."

Session Chair: Hamed I. Ali, *Texas A&M College of Pharmacy*
Co-Chair: Khaldoun Abdelwahed, *University of Texas at Tyler*

7:30-8:00: *Session Keynote*: Dr. Dai Lu, *Texas A&M health Science Center*



Dr. Dai Lu is an associate professor of pharmaceutical sciences at the College of Pharmacy, Texas A&M health Science Center. Dr. Lu obtained his Ph.D. degree in medicinal chemistry and pharmaceutical sciences from the University of Connecticut in 2005. He also holds a MS degree in medicinal chemistry from Peking Union Medical College (PUMC) and Chinese Academy of Medical Sciences, and a bachelor's degree in organic chemistry from Nankai University, China. Prior to his tenure at Texas A&M university, He holds a junior faculty position as an instructor of neurology and molecular pharmacology at Harvard Medical School while he was a senior chemist in the Center for Neurologic Diseases of Brigham and Women's Hospital. Before his independent career in academia, he was trained as a postdoctoral research fellow in Harvard Medical School and a fellow of National Service Award from NIH. The Lu lab at Texas A&M is engaged in the discovery of potential therapeutics for the treatment of pain, cancer, and neurodegenerative diseases. The current research projects in the Lu lab include the synthesis of allosteric modulators for the cannabinoid CB1 receptor, water-soluble Paclitaxel, selective agonists for the cannabinoid CB2 receptor, inhibitors of Abelson kinases ABL1 and ABL2, and inhibitors of calmodulin kinase-like vesicle-associated protein (CaMKV). The novel ABL kinase inhibitors discovered in the Lu lab showed therapeutic promise for the treatment of triple negative breast cancer (TNBC). The selective CB2 receptor agonists developed in the Lu lab showed potential in the treatment of neuropathic pain and pancreatic cancer. The CaMKV inhibitors discovered in the Lu lab are potent against neuroblastoma in preclinical studies. At present, the most impactful project in the Lu lab is the discovery of non-opioid and non-addictive pain suppressors from positive allosteric modulators (PAMs) of cannabinoid CB1 receptor. This class of CB1 allosteric ligands not only has great promise for the management of chronic pain, but also has the potential for the treatment of glaucoma, Parkinson's disease, and Huntington disease. Dr. Lu's contributions in pharmaceutical sciences include the discovery of the first type of intrinsically fluorescent ligands for the cannabinoid CB1 and CB2 receptors, the discovery of the first selective agonist for the CB2 receptor, the discovery of a novel class of Abelson kinase inhibitors, and the discovery of an anxiolytic drug candidate Buagafuran, which is currently in Phase III clinical trial in China. Dr. Lu is a leading inventor or co-inventor of 12 patents. His research has been continuously supported by the National Institute on Drug Abuse (NIDA) and National Institute of Neurological Disorders and Stroke (NINDS).

Room# WTB 234	Session 16: "From Atoms to Algorithms: Medicinal Chemistry and CADD for Next-Gen Therapeutics." **Session Chair**: Hamed I. Ali, *Texas A&M College of Pharmacy* **Co-Chair:** Khaldoun Abdelwahed, *University of Texas at Tyler*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
Keynote	**7:30**	**16-1**	Targeting the Allosteric Site of Cannabinoid CB1 Receptor for Developing Non-opioid Pain medicine ***Dai Lu*** *Department of Pharmaceutical Sciences, College of Pharmacy, Texas A&M health Science Center*	**Dai Lu**
211	**8:00**	**16-2**	New Benzofuran-Pyrazole-Based Compounds as Promising Antimicrobial Agents: Design, Synthesis, DNA Gyrase B Inhibition, and In Silico Studies ***Sameh Abdelwahed*** *Prairie View A&M University*	**Sameh Abdelwahed**
150	**8:15**	**16-3**	Integrated Computational Strategies for Accelerated Drug Discovery Against Global Health Threats ***Eneye Ajayi,*** *Mostafa Aref, Md Emran Hossain, Rokaia Abdullah, Ling Yang, Yinan Wei, Hamed Ali* *Department of Pharmaceutical Sciences, Irma Lerma Rangel College of Pharmacy, Texas A&M University.*	**Eneye Ajayi**
89	**8:30**	**16-4**	Computational Predictions of Positive Allosteric Modulator Binding Sites in High-Sensitivity (α4)2(β2)3 Nicotinic Acetylcholine Receptors Using PAM-Bound Cryo-EM Structures ***Khaldoun Abdelwahed****, Emily Phelps, Ayman hamouda* *Department of Pharmaceutical Sciences and Health Outcomes, University of Texas at Tyler*	**Khaldoun Abdelwahed**
170	**8:45**	**16-5**	Advanced Selective Kinase Inhibitors for Enhanced Treatment of CNS Metastases of Breast Cancer ***Mostafa Aref****, Md Emran Hossain, Eneye D. Ajayi, Rokaia Abdullah, Hamed I. Alyismail* *Department of Pharmaceutical Sciences. Irma Lerma Rangel College of Pharmacy | Texas A&M University*	**Mostafa Aref**
174	**9:00**	**16-5**	"Discovery of Potent Anticancer Kinase Inhibitors via Integrated In Vitro and In Vivo Screening" *Md Emran Hossain, Rokaia Abdullah, Eneye D. Ajayi, Mostafa M.A Aref, Hamed I. Ali* *Department of Pharmaceutical Sciences, Irma Lerma Rangel College of Pharmacy, Texas A&M University*	***Md Emran Hossain***
185	**9:15**	**16-6 (International)**	Unveiling New Agents for Mutant HER2T798I Breast Cancer: In silico study ***Wafa Masoud****[1], Radwan alnajjar[2], Hamed I. Ali Ali[3]* *[1]Department of Pharmaceutical Sciences, PharmD Program, School of Health and Medical Science, Libyan International University, Benghazi, Libya, [2]CADD Unit, Faculty of Pharmacy, Libyan International University, [3]Department of Pharmaceutical Sciences, Irma Lerma Rangel College of Pharmacy, Texas A&M University, College Station, TX, USA*	**Wafa Masoud**

Coffee Break and Visit the Posters

Room# WTB 133	**Session 17: Clinical Rehab** **Session Chair**: Albert Manero, *University of Central Florida* **Co-Chair:** Felix Adah, *University of Mississippi Medical Center*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
100	**9:30**	**17-1**	Limbitless Journey: Advancing Low Stress Hands-Free Mobility Training through VR and MR Gaming ***Maanya Pradeep***, *Alex Da Vera Cruz, Delaney Gunnell, Pavan Senthil, Peter Smith, Matt Dombrowski, John Sparkman, Albert Manero* *University of Central Florida*	**Maanya Pradeep**
95	**9:45**	**17-2**	Hand Dexterity Evaluation in Virtual Reality: A Framework for Sensorimotor Assessment ***Ethan Bell***, *Sophie Bennett, Alex Da Vera Cruz, Delaney Gunnell, Abrianna Lalle, Maanya Pradeep, Pavan Senthil, Peter Smith, Matt Dombrowski, John Sparkman, Albert Manero* *Limbitless Solutions*	**Ethan Bell**
240	**10:00**	**17-3**	Chronic Plantar Fasciitis Responses to Radial/Low Energy Extracorporeal Shock Wave Therapy: A Systematic Review ***Felix Adah***, *University of Mississippi Medical Center*	**Felix Adah**
79	**10:15**	**17-4**	Lumbar load analysis in the sweeping gesture *Laura Valentina Castro Castañeda, Derian Espinosa, Deysi Yohanna* ***Gómez Rey*** *Universidad Militar Nueva Granda,* Columbia	**Gómez Rey**
151	**10:30**	**17-5**	Smartphone-Enabled Point of Care Sensing and Imaging Tools for Medical Applications ***Hatice Ceylan Koydemir*** *Department of Biomedical Engineering, Texas A&M University*	**Hatice Ceylan Koydemir**
234	**10:45**	**17-6**	A Dynamic Ankle Orthosis Improved Patient Comfort During Extended Wear Compared to an Orthopedic Walking Boot ***PJ Johnson***, *MR Paquette, DJ DiAngelo,* *University of Tennessee Health Sciences*	**PJ Johnson**

Session 18: Nanomedicine

Session Chair: Santosh Aryal, University of Texas at Tyler
Co-Chair: Narendhirakannan, *Kongunadu Arts and Science College, India*
9:30-10:00 AM: Session Keynote, Dr. Sunil Krishnan



Dr. Krishnan is a professor and director of radiation oncology at UT Health Science Center in Houston. He received his medical degree from Christian Medical College, Vellore, India and completed a radiation oncology residency at Mayo Clinic, Rochester, Minnesota. He moved to MD Anderson Cancer Center, Houston, TX after residency and rose to full professor of radiation oncology there and was the director of the Center for Radiation Oncology Research. He briefly worked at Mayo Clinic Florida before returning to Houston where he is based at the Institute of Molecular Medicine. His clinical expertise is in the treatment of patients with hepatobiliary, pancreatic, and rectal tumors with radiation therapy. His laboratory evaluates new strategies to sensitize tumors to radiation using gold nanoparticles, chemotherapeutics, and biologics.

Room# 136	**Session 18: Nanomedicine** **Session Chair**: Santosh Aryal, University of Texas at Tyler **Co-Chair:** Narendhirakannan, *Kongunadu Arts and Science College, India*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
159	**9:30**	**Keynote**	Overcoming barriers to nanoparticles reaching tumors via the blood stream and overcoming depth limitation of light to trigger tumor events ***Sunil Krishnan*** *UTHealth Houston*	**Sunil Krishnan**
105	**10:00**	**18-1**	Macrophage-mediated Breast Cancer Liver Metastasis therapy with lipid nanoparticles carrying siRNA for EphA2: in vitro and in vivo studies ***Anjana Tiwari***[1], *Eric Chau*[1], *Jenna Carr*[1], *Arvind Pandey*[2], *LaMargaret T. Johnson*[3], *Dylan A Goodin*[3], *Hermann B. Frieboes*[3], *Biana Godin*[1] [1]*Department of Nanomedicine, Houston Methodist Research Institute, Houston, TX* [2]*Department of Neurosurgery, Houston Methodist Research Institute, Houston, TX* [3]*Department of Bioengineering, University of Louisville, Louisville, KY*	**Anjana Tiwari**
97	**10:15**	**18-2**	Mitochondrial function restoration as a powerful therapeutic avenue in atherosclerosis ***Elvin Blanco*** *Houston Methodist Research Institute*	**Elvin Blanco**
207	**10:30**	**18-3**	Ultrasound-Responsive SonoScaffolds for Remote Control of Cell Signaling ***Carolyn Schutt Ibsen*** *Oregan Health Science University*	**Carolyn Schutt Ibsen**
200	**10:45**	**18-4**	Pancreatic Cancer Detection using Dielectrophoresis-Based Recovery of Circulating Cancer-Derived Nanoparticles ***Stuart Ibsen*** *CEDAR, Knight Cancer Institute, Oregon Health and Science University*	**Stuart Ibsen**

Session 19: Biology and Biochemistry

Session Chair: May Abdelaziz, The University of Texas at Tyler
Co-Chair: Ibrahim Farah, Jackson State University

9:30-10:00 AM: Session Keynote, Dr. Andrey Komissarov, , *The UT Tyler School of Medicine, Tyler, TX*



Dr. Komissarov has worked for UTHSCT for 18 years, focusing on understanding the molecular mechanisms of fibrinolysis in pleural injury and its translation from the bench to the bedside in the form of novel, efficacious therapeutics. During that time, his research was continuously supported by internal and extramural grants, yielding almost 40 peer-reviewed publications and 90 presentations. He currently serves as the contact PI on two MPI R01 awards funded by NIH/NHLBI, both of which focus on the development of novel low-dose treatments for empyema. Dr. Komissarov's research focuses on understanding the molecular mechanisms of fibrinolysis and modulation of the serpin-fibrinolysin interactions, low dose fibrinolytic therapy of pleural injury in infection and scaring models, liposome and nanoparticles-based drug encapsulation and delivery, novel assays for evaluation of severity of the disease and prediction therapeutic outcome, selection, design and characterization of inhibitors of plasminogen activator inhibitor-1 (PAI-1). Currently, PAI-1-targeted fibrinolytic therapy (PAI-1-TFT), a therapeutic approach built from two decades of research exploring the molecular mechanisms behind fibrinolysis and fibrinogenesis, is moving towards commercialization and application in clinical practice. In addition to research, Dr. Komissarov teaches in UTHCT's Master's in Biotechnology program and mentors students and young investigators of different (K-12 to postdoctoral) levels. Dr. Komissarov collaborates with researchers in four UT systems as well as several academic institutions from four countries (the United States, Belgium, Australia, and the United Kingdom) and two US biotechnology companies.

Room# 137	**Session 19: Biology and Biochemistry** **Session Chair**: May Abdelaziz, The University of Texas at Tyler **Co-Chair:** Ibrahim Farah, Jackson State University			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
67 Keynote	**9:30**	**Keynote**	Inhibiting the inhibitor: would targeting PAI-1 result in a low-dose, well-tolerated treatment of empyema? ***Andrey Komissarov***[1], *Christian De Vera*[1], *René Girard*[1], *Krishna Sarva*[1], *Rebekah Emerine*[1], *Ali Azghani*[2], *Sunil Christudas*[1], *Jincy Jacob*[1], *Mignote Chamiso*[1], *Danna Morris*[1], *Sophia Karandashova*[1], *Paul Declerck*[3], *Steven Idell*[1], *Galina Florova*[1] [1]*Department of Cellular and Molecular Biology, The UT Tyler School of Medicine, Tyler, TX* [2]*Department of Biology, The University of Texas at Tyler, TX* [3]*Laboratory for Therapeutic and Diagnostic Antibodies, Department of Pharmaceutical and Pharmacological Sciences, KU Leuven, Belgium*	**Andrey Komissarov**
111	**10:00**	**19-1**	Novel Mechanisms in Pleural Fibrosis: Role of coagulation protease-induced extracellular vesicles *Wenyi Qin*[1], *Shuzi Owens*[1], *Luis Destarac*[2], *Steven Idell*[1], *Vijaya Mohan Rao Lella*[1], *Torry Tucker*[1], ***Shiva Keshava***[1] [1]*UT Tyler Health Science Center* [2]*UT Health East Texas*	**Shiva Keshava**
85	**10:15**	**19-2**	In-Silico Design of Therapeutic Peptides to Prevent Insulin Aggregation ***Thanh Tien Dao***, *Nicolas Campos, Bidisha Sengupta* *Stephen F. Austin State University*	**Thanh Tien Dao**
50	**10:30**	**19-3**	Phospholipid transporters—why have three? *Ashutosh Rai*[1], *Katsuhiro Sawasato*[2], *Anastasiia Kozlova*[2], *Haley Bennett*[1], *Genevieve Sparagna*[3], *Mikhail Bogdanov*[2], ***Angela Mitchell***[1] [1]*Department of Biology, Texas A&M University* [2]*Department of Biochemistry and Molecular Biology, McGovern Medical School at The University of Texas Health Science Center at Houston* [3]*Department of Medicine, Division of Cardiology, University of Colorado Anschutz Medical Campus*	**Angela Mitchell**
28	**10:45**	**19-4**	Roles Of Striatal Neuronal and Synaptic Plasticity And Dopamine D2r Isoforms in Drug-Induced Dyskinesia ***YanYan Wang*** *Department of Cellular and Molecular Biology, The University of Texas at Tyler School of Medicine, Tyler, Texas*	**Yan Yan Wang**

Room# 234	**Session 20: AI & Ethics** **Session Chair**: Richard Wilson, *Towson University* **Co-Chair:** Joseph A. Cameron,Jr *National American University*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
192	**9:30**	**20-1**	AI in Your Pocket: A Smartphone Platform for Building Medical Chatbots ***Deepa Reghu***, *Victor Bii, Charles Bland* *Department of Natural Sciences and Environmental Health, Mississippi Valley State University, Itta Bena, MS*	**Deepa Reghu**
74	**9:45**	**20-2**	AI Assisted Technology Detects Nanoparticles in Water: Ethical Considerations for Human Health ***Benjamin Rozencwaig***[1], *Richard Wilson*[2] [1]*Towson High School,* [2]*Towson University*	**Benjamin Rozencwaig**

73	10:00	20-3	Face Recognition Based Applications and Disease Diagnosis: Ethical and Anticipated Ethical Issues ***Eunice Hong***, *Richard Wilson* *Towson University*	**Eunice Hong**
68	10:15	20-4	Artificial Intelligence in the Medical School Curriculum: Anticipated Ethical Issues ***Richard Wilson*** *Towson University*	**Richard Wilson**
114	10:30	20-5 (International)	Targeting -1 Programmed Ribosomal Frameshifting in SARS-CoV2: From Rational Drug Repurposing to Mechanistic Insights ***Ahmed Mohamed Ragab Mohamed Sanad***[1], *Sui-Yuan Chang*[2], *Jin-Der Wen*[3], *Lee-Wei Yang*[1] [1]*Institute of Bioinformatics and Structural Biology, National Tsing Hua University* [2]*Department of Laboratory Medicine, National Taiwan University Hospital, Taipei 100, Taiwan* [3]*Institute of Molecular and Cellular Biology, National Taiwan University, Taipei, Taiwan*	**Ahmed Mohamed Ragab Mohamed Sanad**

11:00-11:15: Coffee BreaK

Room# 133	**Session 21: Biomechanics II** **Session Chair**: Tanvir Faisal, University of Louisiana at Lafayette **Co-Chair:** Md Rasidul Islam, The University of Texas at Tyler			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
18	11:15	21-1	Synergistic Impact of Enzyme Mediation and Traumatic Insults on Morpho-Mechanical Properties of Joint Cartilage ***Asif Istiak***, *Tanvir Faisal* *University of Louisiana at Lafayette*	**Asif Istiak**
19	11:30	21-2	Computational Homogenization of the Mechanics of Depth-Dependent Articular Cartilage under Compressive Loading ***Md Saiful Islam***, *Tanvir Faisal* *Department of Mechanical Engineering, University of Louisiana at Lafayette, Lafayette, LA, USA*	**Md Saiful Islam**
21	11:45	21-3	Modeling an Auxetic Helmet Liner for NFL Impact Scenarios: A Finite Element Approach ***Md Imrul Kayes***, *Tanvir Faysal* *University of Louisiana at Lafayette*	**Md Imrul Kayes**
113	12:00	21-4	Effects of Frequency and Amplitude on Osteoblast-Like Cell Viability and Metabolism Under Vibrational Loading ***Eric Flynn Mabowitz***, *Steven Elder, Matthew Ross, Hamed Bakhtiarydavijani, Debarshi Roy, LaShan Hendrix, Raheleh Miralami* *Mississippi State University, Alcorn State University, University of Cincinnati*	**Eric Flynn Mabowitz**

11:15-12:15 Workshop-2 Vital Connections for Researchers Room #234

Chair: Angela Nunez; Director, Office of Sponsored Programs, The University of Texas at Tyler

Overview This workshop explores the vital connection between faculty and research administration, emphasizing how strong relationships lead to more successful, compliant, and impactful research.

Objectives

At the end of this workshop, participants will:

- Foster awareness of the distinct roles, responsibilities, and pressures faced by faculty and research administrators.
- Learn strategies clear, respectful, and timely communication to reduce misunderstandings and delays.
- Highlight examples of effective partnerships to inspire and model best practices.

Learning outcomes

Upon completion, participants will be able to:

- Articulate the distinct roles and responsibilities of faculty and research administrators in the research life cycle.
- Recognize common sources of tension or misalignment and propose strategies to address them collaboratively.
- Apply effective communication techniques to foster transparency, responsiveness, and mutual respect.

Session 22: AI and Wearable Technologies for Smarter Healthcare Outcomes

Session Chair: Prabha Sundaravadivel, *The University of Texas at Tyler*
Co-Chair: Premananda Indic, *The University of Texas at Tyler*
11:15-11:45: Session Keynote, **University of Texas at Dallas**



Dr. Sriraam Natarajan is a Professor and the Director for Center for ML at the Department of Computer Science at University of Texas, Dallas. He is a AAAI fellow, hessian.AI fellow and a RBCDSAI Distinguished Fellow at IIT Madras. His research interests lie in the field of Artificial Intelligence, with emphasis on Machine Learning, Statistical Relational Learning and AI, Reinforcement Learning, Graphical Models and Biomedical Applications. He has won several awards including the President's teaching award for excellence in graduate teaching, the Young Investigator award from US Army Research Office, several industry awards and best paper awards. He was the program co-chair of AAAI 2024, SDM 2020 and ACM CoDS-COMAD 2020 conferences. He is an associate editor of MLJ, JAIR and DAMI journals and is an elected member of AAAI executive council.

Room# 136	Session 22: AI and Wearable Technologies for Smarter Healthcare Outcomes **Session Chair**: Prabha Sundaravadivel, *The University of Texas at Tyler* **Co-Chair:** Premananda Indic, *The University of Texas at Tyler*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
13 **Keynote**	**11:15**	**Keynote**	Human-allied AI -- Automate or Collaborate? ***Sriraam Natarajan*** *University of Texas at Dallas*	**Sriraam Natarajan**
229	**11:45**	**22-1**	Enabling On-Device Automation of Low-Power Wearable Energy Management Systems ***Shekhar Suman Borah***[1], *Mustafa Hannoun*[2], *Premananda Indic*[1], *Prabha Sundaravadivel*[1] [1]*Department of Electrical and Computer Engineering, The University of Texas at Tyler, Tyler, Texas, USA 75799* [2]*Independent Researcher, Austin, Texas, USA*	**Shekhar Borah**
230	**12:00**	**22-2**	AI Powered Early Morbidity Detection in Preterm Infants: An Application to Bronchopulmonary Dysplasia ***Pravitha Ramanand***[1], *Rhythem Tahrin*[1], *Premananda Indic*[1], *Namasivayam Ambalavanan*[2] [1]*Department of Electrical and Computer Engineering, The University of Texas at Tyler, TX* [2]*Department of Neonatology, University of Alabama at Birmingham, AL.*	**Pravitha Ramanand**
238	**12:15**	**22-3**	Fracture Detect: AI-Driven Computer Vision for Accurate Bone Fracture Detection and Classification ***Chase Brown***, *Prabha Sundaravadivel* *The University of Texas at Tyler*	**Chase Brown**

Room# WTB 137	Session 23: Career Development Panel Session Chair: May Abdelaziz, *University of Texas at Tyler* Co-Chair: Shashi Kant, *The University of Texas at Tyler*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
210	**11:15-12:15**	**23-1**	Balancing Act: A Career in Academia ***Shashi Kant*** *The University of Texas at Tyler*	**Shashi Kant**
148	**11:15-12:15**	**23-2**	Taking Projects to the Next Level: From Ideas to Entrepreneurship ***Matthew Lucci*** *Runatek*	**Matthew Lucci**
84	**11:15-12:15**	**23-3**	A Career in STEM for Women and Underrepresented Minorities ***May Abdelaziz*** *The University of Texas at Tyler*	**May Abdelaziz**

12:30-1:30 Symposium on Biomaterials Trend, Lunch provided, Room# WTB 133

Moderator: Dr. Amol V. Janorkar, University of Mississippi Medical Center

Description: *The "Biomaterials: Lessons Learned and New Directions" panel will discuss the key breakthroughs, challenges, and translational insights in biomaterials development and applications. Experts will discuss a variety of aspects including biomaterials synthesis, characterization, biomanufacturing, biocompatibility testing, immune responses, and clinical performance. The panel will also highlight emerging materials and techniques.*

Speakers: Dr. Anthony McGoron, Dr. Eden Tanner, Dr. Vladimir Reukov, Dr. Ham Benghuzzi, and Dr. Amol Janorkar (Moderator)

Format: 60-minute session. Each of the panelist will give a 5-minute presentation (About 2 minutes regarding their experience and about 3 minutes about the issues they have experienced in biomaterials development). Then the moderator will open up the sessions from any Q&A from the audience.

Speakers Background"

Dr. Ham Benghuzzi, and Dr. Amol Janorkar (Moderator) bios are listed at the beginning of the program.



Anthony McGoron is a Professor of Biomedical Engineering at the College of Engineering and Computing at Florida International University. He received his PhD in Biomedical Engineering from Louisiana Tech University and post-doctoral training in the Department of Pharmacology and Cell Biophysics at the University of Cincinnati College of Medicine. Before Joining FIU he was an Assistant Professor at the University of Cincinnati Department of Radiology, Divisions of Nuclear Medicine and Medical Physics. He is a Fellow of the American Institute for Medical and Biological Engineering (AIMBE). He served as Chair of the Department of Biomedical Engineering from 2007-2010 and Associate Dean for Academic Affairs from 2015-2023. He was National President to the Alpha Eta Mu Beta Biomedical Engineering Honor Society 2010-2014. He has over 200 journal articles, book chapters and proceeding papers. He has received funding from the NIH, NSF, DOD, AHA, and Fl-DOH as well as from industry. His primary area of research focuses on dosimetry and image guided drug delivery and therapy of cancer using polymer and inorganic nanoparticles and drug-polymer conjugates. Imaging modalities include nuclear (PET/SPECT), near-infrared fluorescence, and surface enhanced Raman spectroscopy.



Dr. Eden E. L. Tanner completed her undergraduate degree in Advanced Science (Chemistry) at the University of New South Wales, Sydney, Australia. She earned her doctorate in Physical and Theoretical Chemistry at the University of Oxford with Prof Richard G. Compton, and moved to Harvard University in 2017 as a Postdoctoral Research Fellow with Samir Mitragotri. As of August 2020, Dr. Tanner is an Assistant Professor of Chemistry and Biochemistry at the University of Mississippi and a co-director of the Centre for Nano-Bio Interactions. The Tanner Lab works at the interface of Chemistry and Bioengineering with a focus on using ionic liquids to solve problems in nanoparticle drug delivery.



Dr. Vladimir Reukov is an Assistant Professor of Polymer, Fiber, and Textiles Sciences at the University of Georgia's Department of Textiles, Merchandising, and Interiors. He received his BS/MS in Materials Science and a Ph.D. in Chemistry from Moscow State University, followed by a postdoctoral fellowship at Clemson University. Dr. Reukov has been recognized with several awards, including the 2022 Undergraduate Mentoring Award, the 2018 Mary Bradley Award for Mentoring in Creative Inquiry, the 2018 Dr. Fred D. Bisplinghoff Research Innovation Award, and the 2016 Innovision Award. He is an active member of the Society for Biomaterials, the Biomedical Engineering Society, the Materials Research Society, and the Fibers Society. His research is supported by the National Science Foundation, the National Institutes of Health, and the Georgia Research Alliance.

1:30-1:45 Break

Session 24: Medical devices and implants, Room #: WTB 133

Session Chair: Giovanni Solitro, *Louisiana State University Health Sciences Center*
Co-Chair: Mario Lobao, *Louisiana State University Health Sciences Center*

1:45-2:15: Session Keynote, Dr. Donald Lynn Sorrells, *LSU Health, Shreveport*



Donald Lynn Sorrells, MD, a board-certified Pediatric and General Surgeon, currently serves as an Associate Professor of Surgery at Louisiana State University School of Medicine in Shreveport. A former United States Air Force Major, Dr. Sorrells was honorably discharged after four years of distinguished service, including a deployment to Kuwait in 2001.

Dr. Sorrells began his academic journey in a rigorous six-year accelerated medical program, earning a Bachelor of Science in Science and Medicine from Louisiana State University in Shreveport. He completed his General Surgery residency at LSU Medical Center under the mentorship of Dr. John C. McDonald, a pioneering figure who introduced organ transplantation to northwest Louisiana and established both the Regional Burn Center and the Level One Trauma Center.

During his training, Dr. Sorrells also completed a year of dedicated research at the Children's Hospital of Pittsburgh, working under the guidance of renowned surgeons Dr. Marc Rowe and Dr. Henri Ford. Following his military service, he further specialized by completing a Pediatric Surgery fellowship at Hasbro Children's Hospital/Brown University in Providence, Rhode Island, in 2005.

Dr. Sorrells has practiced Pediatric Surgery in Shreveport, Louisiana, for the past twenty years and has an extensive record of publications and participation in international conferences in the field. A long-time educator and collaborator with the Department of Cellular and Molecular Biology at LSU Health Shreveport, he has been instrumental in developing cutting-edge treatments for complex pediatric surgical problems. In recent years, he has pioneered novel approaches to intestinal expansion and is currently active in advancing technologies in this area.

Room# WTB 133	**Session 24: Medical devices and implants** **Session Chair**: Giovanni Solitro, *Louisiana State University Health Sciences Center* **Co-Chair:** Mario Lobao, *Louisiana State University Health Sciences Center*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**resenting Author**
193 Keynote	1:45	Keynote	Short Bowel Syndrome: Pursuing a 'Longer' Intestinal Segment via Distraction Enterogenesis ***Donald Sorrells*** *LSU Health, Shreveport*	**Donald Sorrells**
183	**2:15**	**24-1**	GLP-2 Intestinal Expansion Sleeves for in vivo Intestinal Expansion ***Ryan H Field***[1], *Joshua C Colvin*[1], *Jonathan S Alexander*[2], *Donald L Sorrells*[1,] [1]*Department of Surgery, LSU Health Shreveport, LA,* [2]*Department of Molecular and Cellular Physiology, LSU Health Shreveport, LA,* [1]*Department of Surgery, LSU Health Shreveport, LA,,* [2]*Department of Molecular and Cellular Physiology, LSU Health Shreveport, LA*	**Ryan Field**
78	**2:30**	**24-2**	Controlled D50 Injections Reduces Gastrostomy Tube Leakage ***Jensen (Alex) Crifasi***[1], *Fallon Vedros*[1], *Cole Evensky*[2], *Kiley Pulliam*[3], *Donald Sorrells Jr.*[1], *Steven Alexander*[1] [1]*LSU Health Shreveport School of Medicine,* [2]*Willis-Knighton GME Shreveport,* [3]*LSU Health Shreveport*	**Jensen Crifasi**
188	**2:45**	**24-3**	Estrogen-coated Vaginal Expansion Sleeves Expand the Rat Vaginal Canal ***Ashlyn G. Gotberg***, *Joshua C. Colvin, Hannah Meyer, Rachel Cline, Jonathan Steven Alexander, Giovanni Solitro, Donald Sorrells, Mila Shah-Bruce,* [1]*Louisiana State University Health Sciences Center, Shreveport, Louisiana*	**Ashlyn G. Gotberg**
184	**3:00**	**24-4**	An Experimental Investigation of the Dermabond Effect on Knot Strength ***Morgan Brown*** *LSU Health Shreveport*	**Morgan Brown**

Room# WTB 136	**Session 25: Molecular and Tissue Engineering** **Session Chair**: Maricica Pacurari, *Jackson State University* **Co-Chair:** Sohel Quazi, *Texas College*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
30	**1:45**	**25-1**	Prediction Of Osteogenic Differentiation of Mesenchymal Stromal Cells by Cell Molecular Signature ***Qinqin Xu***, *Patrick Massey, Shane Barton, Yufeng Dong* *LSU Health-Shreveport*	**Qinqin Xu**
160	**2:00**	**25-2**	Exploiting radiation-induced tumor vulnerabilities via targeted antibody-drug conjugates ***P.M. Quan Mai***, *Sunil Krishnan, Geraldine Vijay* *UTHealth Houston*	**P.M. Quan Mai**
209	**2:15**	**25-4**	TG-ME-2: An AI-Driven Pipeline for High-Precision Analysis of Spatial Transcriptomics in Human Disease ***Mario Flores*** *The University of Texas at San Antonio*	**Mario Flores**
158	**2:30**	**25-5**	Developing anticancer protein-protein interaction inhibitors targeting HER2 Receptor ***Itzel Montoya***[1, 2], *Phillip Mosier*[3], *May Abdelaziz*[2] [1]*University of Texas at Tyler Department of Chemistry and Biochemistry,* [2]*Fisch College of Pharmacy,* [3]*Medical College of Wisconsin*	**Itzel Montoya**
241	**2:45**	**25-6**	Computational and experimental studies recognized the potential natural metabolites and Antisense oligonucleotides to combat the challenging MRSA and MDR-S. aureus ***Lakshmi PTV*** *Pondicherry University*	**Lakshmi PTV**
49	**3:00**	**25-7**	The Novel Role of Dedicator of Cytokinesis 2 in Cardiovascular Diseases ***Xia Guo*** *University of Texas Health Science Center at Tyler*	**Xia Guo**

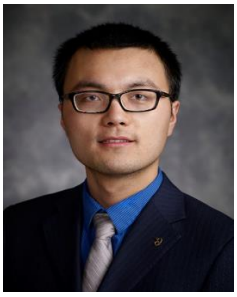
Room# WTB 137	**Session 26: Signaling Pathway** **Session Chair**: Farah Deba, *University of Texas at Tyler* **Co-Chair:** Lakshmi PTV, Pondicherry University, Puducherry, India			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
16	**1:45**	**26-1**	Signal Crosswire: Crosstalk in S. aureus Signaling Systems ***May Abdelaziz*** *The University of Texas at Tyler*	**May Abdelaziz**
165	**2:00**	**26-2**	TREM-1: An Amplifier of Pleural Inflammation in a Rabbit Model of Empyema ***Jincy Jacob***[1], *Christian Jordan De Vera*[1], *Krishna Sarva*[1], *Ali Azghani*[2], *Sunil Christudas*[1], *Alexander Sigalov*[3], *Galina Florova*[1], *Andrey Komissarov*[1] [1]*The Department of Cellular and Molecular Biology, UT School of Medicine, Tyler,TX,* [2]*The department of Biology, University of Texas, Tyler, TX,* [3]*SignaBlok,Inc., Shrewsbury, MA, United States.*	**Jincy Jacob**
130	**2:15**	**26-3**	Fibrinolytic Activity Assay, FPA96F, for Rapid *In Vitro* and *Ex Vivo* Evaluation of Linear Peptides Protecting Fibrinolysins from Plasminogen Activator Inhibitor (PAI-1) ***Oluwaseyi Akiode***, *Rebekah Emerine, Jincy Jacob, Galina Florova, Andrey Komissarov* *Department of Cellular and Molecular Biology, The UT Tyler School of Medicine.*	**Oluwaseyi Akiode**
175	**2:30**	**26-5**	*In vitro* Evaluation of PAI-1 Neutralization by Novel GLP-friendly peptides in Rabbit and Human Mesothelial Cells ***Sunil Christudas***[1], *Jincy Jacob*[1], *Oluwaseyi akiode*[1], *Krishna Sarva*[1], *Christian DeVera Jordan*[1], *Galina Florova*[1], *Andrey Komissarov*[1], *Paul J declerck*[2] [1]*Cellular and molecular biology, UT Tyler school of Medicine, Tyler, TX*	**Sunil Christudas**

			[2]*Laboratory for Therapeutic and Diagnostic Antibodies, department of Pharmaceutical and Pharmacological Sciences, KU, Leuven, Belgium*	
215	**2:45**	**26-6**	Role of Mechanical Impact on the Injury Risk of Neural Cells ***Ashfaq Adnan*** *University of Texas at Arlington*	**Ashfaq Adnan**
90	**3:00**	**26-7**	Therapeutic Potential and Uplc-Orbitrap Mass Spectrometric Profiling Of Watercress Leaf Extracts *Bidisha Sengupta, Nkeiruka Angela Aziekwu, Ken Fiffick, Perla Tovar, Kylie Robertson, Michael Janusa*	**Bidisha Sengupta**

Session 27: Nanomedicine and Drug Delivery IV , Room #: WTB 234

Session Chair: Jayoung Kim, Ph., *University of North Texas Health Science Center*
Co-Chair: Viswanathan Sundaram, PhD., *University of Texas at Tyler*

1:45-2:15: Session Keynote, Zhenpeng Qin, University of Texas at Dallas, 2



Dr. Zhenpeng "ZP" Qin is Professor, Fellow, and Eugene McDermott Distinguished Professor of Mechanical Engineering and Bioengineering at the University of Texas at Dallas, Biomedical Engineering at UT Southwestern Medical Center, and a founding member of the Center for Advanced Pain Studies. His lab develops nanomaterial technologies to better understand, diagnose and treat brain dysfunction, with >$23M support from major agencies like NIH, NSF, DOD, and AHA. Dr. Qin has published extensively and mentored many trainees, with former and current members totaling 48 pre- and postdoctoral trainees and over 50 undergraduates, many of whom have gone on to active academic and industry careers. He has received prestigious awards including the 2024 Dr. Horace Furumoto Innovations Professional Development Young Investigator Award (ASLMS), 2022 ASME Y.C. Fung Early Career Award, NIH/NIGMS MIRA/R35 award, and Collaborative Sciences Award from AHA, and co-created technologies and startups as a co-founder or consultant. Dr. Qin also serves in leadership roles for the ASME Bioengineering Executive Committee. Qin is a fellow of ASME and National Academy of Inventors Senior member.

Room# **234**	**Session 27: Nanomedicine and Drug Delivery IV** **Session Chair**: Jayoung Kim, Ph., *University of North Texas Health Science Center* **Co-Chair:** Viswanathan Sundaram, PhD, *University of Texas at Tyler*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Name of the Presenting Author**
138	**1:45**	**Keynote**	*In vivo* Neuron-Specific Delivery of Biomolecules ***Zhenpeng Qin***[1, 2] [1]*University of Texas at Dallas,* [2]*University of Texas Southwestern Medical Center*	**Zhenpeng Qin**
182	**2:15**	**27-1**	Targeted delivery of therapeutic protein ***Nathaniel Hwang,*** *Seoul National University*	**Nathaniel Hwang**
55	**2:30**	**27-2**	Targeted delivery via HDL-mimicking drug delivery platform to circumvent peripheral toxicity and enhanced therapeutic effect ***Nirupama Sabnis***[1], *Sangram Raut*[2], *Andras Lacko*[1], *Bruce Bunnell*[1] [1]*UNT Health Science Center, Fort Worth, TX,* [2]*Clinical investigations of Texas*	**Nirupama Sabnis**
44	**2:45**	**27-3**	Immunotherapy at the Speed of Sound: Ultrasound-Guided Strategies for Targeted Immune Activation *Sina Khorsandi*[1], *Shea Garland*[1], *Nazia Hafeez*[1], *Wen Jiang*[2], ***Jacques Lux***[1] [1]*UT Southwestern Medical Center,* [2]*MD Anderson Cancer Center*	**Jacques Lux**
34	**3:00**	**27-4**	Severely Polarized Extracellular Acidity in Tumors ***Qiang Feng****, Jinming Gao* *University of Texas Southwestern Medical Center*	**Qiang Feng**
236	**3:15**	**27-5**	Novel nanoparticle-based approaches to overcome longstanding limitations of T cell-based cancer immunotherapy. ***Kareem Azab*** *Department of Biomedical Engineering, UT Southwestern Medical Center, Dallas, TX.*	**Kareem Azab**

3:30-3:45 Coffee Break and visit Posters

Room# 133	Session 28: AI-enhanced Biosensing and Energy Harvesting **Session Chair**: Shawana Tabassum, *The University of Texas at Tyler* **Co-Chair:** Md Masud Rana, *The University of Texas at Tyler*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
33	**3:45**	**28-1**	Effect of Nanomaterial Surface Morphology on the Sensing Performance of Agricultural VOC Sensors: A Review ***A.K.M. Ahsanul Habib***, *Shawana Tabassum* *The University of Texas at Tyler*	**AKM Ahsanul Habib**
81	**4:00**	**28-2**	Doping Controlled Metal Halide Perovskite based Piezoelectric Energy Harvester for Self-powered Sensing ***Md Rasidul Islam***, *Md Adil Hossain[2], Md Masud Rana[3]* *[1]Post Doctoral Fellow, Electrical and Computer Engineering, The University of Texas at Tyler, [2]Graduate Student, Electrical and Computer Engineering, The University of Texas ar Tyler, [3]Assistant Professor, Electrical and Computer Engineering, The University of Texas at Tyler*	**Md Rasidul Islam**
136	**4:15**	**28-3**	Chitosan-Hydrogel Supplements for Enhanced Plant Tolerance: A Computational Framework for Temperature-Triggered Water and Nutrient Release ***Aneesh Karavadi***[1], *Rhythem Tahrin[2], Shawana Tabassum[2]* *[1]Centennial High School, Frisco, TX, [2]The University of Texas at Tyler*	**Aneesh Karavadi**
137	**4:30**	**28-4**	Development of pH-Responsive Hydrogels for Plant Stress Sensing Applications ***Francisco Perez***, *Carla Lacerda, Shawana Tabassum* *The University of Texas at Tyler*	**Francisco Perez**
149	**4:45**	**28-5**	AI-Enhanced Opioid Detection with CGM Biosensors ***Matthew Lucci***[1], *Kyle Walker[1, 2]* *[1]Runatek, [2]Sutter Health*	**Matthew Lucci**
153	**5:00**	**28-7**	AI-Enhanced Wearable Sensing Platform: Real-Time Physiological Monitoring and Nanogenerator Material Optimization for Self-Powered Operation ***Md Adil Hossain***, *Mohammad Solaiman, Md Masud Rana, Shawana Tabassum* *The University of Texas at Tyler*	**Md Adil Hossain**
194	**5:15**	**28-8**	Organic-Inorganic Halide Perovskite and Bio-Based Energy Harvester for Sustainable Self-Powered Wireless Sensing ***Md Masud Rana***, *The University of Texas at Tyler*	**Md Masud Rana**
53	**5:30**	**28-9**	Exploring The Antibiofilm Property Of Mint Extract In Chemically Treated Wastewater From Deep East Texas *Cephus Bess-Grunewald, Olabisi Ogunlewe, Philip Baker, Bidisha Sengupta* *Stephen F. Austin University Department of Chemistry and Biochemistry, Nacogdoches, TX*	**Cephus Bess-Grunewald**

Session 29: Biomaterials, Room # WTB 136

Chair: Melanie Ecker, *University of North Texas*
Co-Chair: Narayan Bhattarai, *North Carolina A&T State University*

3:45-4:15: Session Keynote. Dr. Taylor Ware, Texas A&M University



Dr. Taylor Ware is an Associate Professor in Biomedical Engineering and Materials Science and Engineering at Texas A&M University. Prior to joining TAMU in August 2020, he received his B.S. from the Georgia Institute of Technology (2009) and his Ph.D. from the University of Texas at Dallas (2013) in Materials Science and Engineering. Taylor completed postdoctoral training at the Materials and Manufacturing Directorate at the Air Force Research Laboratory. Dr. Ware was an Assistant Professor from 2015-2020 at the University of Texas at Dallas. His research interests include biomaterials, liquid crystal materials, engineered living materials, flexible electronics, and the interfacing of these technologies in medical devices. Dr. Ware is an author of over 75 peer-reviewed publications. He was a recipient of the Air Force Young Investigator Award (2017), the NSF CAREER award (2018), senior member status of the National Academy of Inventors (2022), and Fellow status of the American Institute for Biological and Medical Engineering (2024).

Room# 136	Session 29: Biomaterials			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
238	**3:45**	**Keynote**	Liquid Crystal Elastomers: Artificial Muscles and Implantable Electronics ***Taylor Ware*** *Texas A&M University, College Station, TX*	**Taylor Ware**
98	**4:15**	**29-1**	Thiol-Clickable Gelatin-Based Hydrogels for 3D Cell Culture ***Sara Swank***, *Melanie Ecker* *University of North Texas, Denton, TX*	**Sara Swank**
23	**4:30**	**29-2**	Advanced shape memory polymers: An additive manufacturing approach for next generation biomaterials *Melanie Ecker,* ***Raj Kumar Pittala****, Neha Pramod Davange* *University of North Texas, Denton, TX*	**Raj Kumar Pittala**
141	**4:45**	**29-3**	Zinc-Integrated PLGA/Chitosan Nanofiber Composites Meshes: Fabrication and Characterization for Potential Biomedical Applications ***Dekonti Davies****, Jagannathan Sankar, Narayan Bhattarai* *North Carolina A & T State University, Greensboro, NC*	**Dekonti Davies**
157	**5:00**	**29-4**	Coculture of HDFn and HUVECs on zinc-functionalized fibrous scaffolds *Sita Shrestha,* ***Narayan Bhattarai****, Niranjan Parajuli* *North Carolina A&T State University, Greensboro, NC*	**Narayan Bhattarai**
133	**5:15**	**29-5**	Touch-Spun Microfiber Scaffolds: A Promising Platform For Tissue Engineering Applications *Kristina Peranidze, Mikhail Parker, Nataraja Yadavalli, Sergiy Minko,* ***Vladimir Reukov,*** *The University of Georgia, Athens, GA*	**Vladimir Reukov**

Session 30: Nanomedicine 2, Room # WTB 137

Session Chair: Dustin Patterson, *The University of Texas at Tyler*
Co-Chair: Jiyong Lee, *The University of Texas at Tyler*

3:45-4:15: Session Keynote, Biana Godin, HMRI



Dr. Biana Godin earned her Ph.D. in Pharmaceutical Sciences from the School of Pharmacy, The Hebrew University of Jerusalem, Jerusalem, Israel. During her Ph.D. studies, Dr. Godin focused on designing a non-invasive treatment for the hard-to-treat deep skin infections and on nasal delivery of proteins. She completed postdoctoral fellowship in Cancer Nanotechnology at the Institute of Molecular Medicine, University of Texas Health Sciences Center in Houston. Her postdoctoral research focused on design and evaluation of injectable nanotherapies for cancer treatment and imaging. Currently, Dr. Godin is an Associate Professor at the Department of Nanomedicine in Houston Methodist Research Institute (HMRI), Weill Cornell Medical College (WCMC) Department of Obstetrics and Gynecology (Ob/Gyn) and Department of Ob/Gyn, Center for RNA therapeutics and Cancer Center at Houston Methodist Hospital (HMH) and have Adjunct Appointments at the Ob/Gyn Department of School of Medicine, University of Texas Health Since Center and Department of Biomedical Engineering, Texas A&M College Station. Dr. Godin has background in pharmaceutical sciences with an extensive training in physiologically relevant *in vitro* and *in vivo* disease models, biomedical nanotechnology and design/investigation of novel therapeutics and diagnostics based on the biophysical factors in the disease microenvironment.

Research in Dr. Godin's lab, funded by federal, state and foundation grants with >$7M in total funding and has a proven track record with >350 research publications including high-profile original papers, reviews and invited/keynote presentations at national and international meetings with >48K reads (ResearchGate) and >14.5K citations (Google Scholar). She has mentored >30 trainees some of whom are currently pursuing independent faculty positions and have leading roles in various industries, directed large research and administrative teams, chaired scientific and institutional committees, contributed as an editor and in a reviewer capacity to >50 scientific journals, contributed to multiple national and international scientific grant review panels. Dr. Godin is a translational researcher on the intersection of biological and physical sciences, with the goal of bringing advanced and safe therapies and novel methods to personalize therapies into the clinic to benefit patients.

Room# 137	**Session 30: Nanomedicine 2** **Session Chair**: Dustin Patterson, *The University of Texas at Tyler* **Co-Chair:** Jiyong Lee, *The University of Texas at Tyler*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
213	3:45	Keynote	Nanomedicine for cancer therapy: from drug delivery to poorly vascularized tumors to protection from radiotherapy induced damage in the skin ***Biana Godin*** *HMRI*	**Biana Godin**
93	4:15	30-1	Self-Assembling Protein and Peptide Systems as Scaffolds for Drug Delivery, Nanomedicine, and Drug Discovery ***Dustin Patterson*** *University of Texas at Tyler*	**Dustin Patterson**
117	4:30	30-2	Development of a Novel Microbubble Based Platform for Targeted Inhibition of Genes ***Nazia Hafeez***, *Sina Khorsandi, Nicole McCuen, Adam Woodward, Ruoqi Gao, Shea Garland, Jacques Lux* *UT Southwestern Medical Center*	**Nazia Hafeez**
112	4:45	30-3	Microbubble-Mediated Intracellular Peptide Delivery via Bioreducible Bonds **Shea Garland**[1], Jacques Lux[1], Wen Jiang[2] [1]UT Southwestern Medical Center, [2]MD Anderson Cancer Center	**Shea Garland**
22	5:00	30-4	Development of Targeted Nanoparticles to Enhance Drug Delivery for Peripheral Arterial Disease Treatment ***Na Nguyen***, *Vy Tran, Priyanka Iyer, Kytai Nguyen, Tam Nguyen* *University of Texas at Arlington*	**Na Nguyen**
4	5:15	30-5	Convergence of 3D bioprinting, organoid, and MPS technologies in a pillar/perfusion plate ***Moo-Yeal Lee***[1], *Soo-Yeon Kang*[1], *Sunil Shrestha*[1], *Prabha Acharya*[1], *Vinod Lekkala*[1], *Mona Zolfaghar*[1], *NaYoung Choi*[1], *Minseong Lee*[1], *Manav Vanga*[2], *Pranav Joshi*[2] [1]*University of North Texas* [2]*Bioprinting Laboratories Inc.*	**Moo-Yeal Lee**

Session 31: Biomedical Education/Research Training, Room # WTB 234

Session Chair: Joseph A. Cameron, *Jackson State University*
Co-Chair: Xiaoshan "Judy" Gordy, *University of Mississippi Medical Center*

3:45-4:15: Session Keynote, Dr. Jamil Ibrahim, Mississippi Academy of Sciences



Dr. Jamil Ibrahim has over 30 years of research and teaching experience. He had multiple appointments where he worked as Scientist IV, Research Supervisor, Associate Professor at SHRP, and Associate Professor at the School of Medicine, Department of Dermatology at the University of Mississippi Medical Center (UMMC). He has extensive work experience in teaching, research, and service. He taught graduate and undergraduate courses in Biostatistics, Research, Health Care Decision Making, and Epidemiology. He has a strong track record of academic and research achievements, including publications and presentations at MAS and other scientific societies, and he has participated in various research projects regionally and nationally. He has authored and co-authored many peer- reviewed scientific papers and presented over 100 abstracts at conferences and meetings nationwide. He has also demonstrated a strong commitment to advancing science and contributed several times to his respective scientific organizations, including MAS, where he has also played leadership roles as chair and co-chair of the Math, Computer Science, and Statistics divisions. He is the Mississippi Academy of Sciences President-elect and has received many awards from MAS. Dr. Ibrahim received numerous awards, including the Gold Humanism Award from UMMC and the Unsung Hero Award from the Mississippi Association of Institutional Research. Over the years, Dr. Ibrahim has been involved with many grants, research, and service activities, including developing, chairing, and administering the campus-wide faculty, student, and employee assessment and evaluation activities. He also served on curriculum committees, educational committees, research committees, service and scholarship committees and web committees at schools' level, departmental level and institutional levels at the UMMC including the Institutional Assessment Committee, Academic Affairs Council Committee, School of Medicine Admissions Interview Subcommittee, School of Medicine Curriculum Committee, Opioid Research and Stewardship Program Committee, Research Affairs Committee, and the Southern Association of Colleges and School Commission on Colleges (SACSCOC) Writing Committee. In addition to his role at the UMMC as a statistical consultant, Dr. Ibrahim is a graduate adjunct faculty member at the JSU School of Population Health, where he taught courses in Biostatistics, Public Health, and Epidemiology.

Room# 234	**Session 31: Biomedical Education/Research Training** **Session Chair**: Joseph A. Cameron, *Jackson State University* **Co-Chair:** Xiaoshan "Judy" Gordy, *University of Mississippi Medical Center*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
240	**3:45**	**Keynote**	Biomedical and science education fields and the role of faculty in training the future generations of scientists *Jamil Ibrahim,* *University Medical Center of Southern mississippi*	**Jamil Ibrahim**
187 (Invitee)	**4:15**	**31-1**	Exploring Burnout and Turnover Intentions Among Nursing Faculty in Mississippi ***Xiaoshan` Gordy***, *Angela Duck, Christy Savell, Margaret Calcote, Tawanda McNair, Xiaoqian Zhu, University of Mississippi Medical Center*	**Xiaoshan "Judy" Gordy**
156 (Invitee)	**4:45**	**31-2**	Motivational Approaches, Outcomes, and Implications in Medical Education ***Tim Dasinger*** *University of Mississippi Medical Center*	**Tim Dasinger**
178 (Invitee)	**5:00**	**31-3**	A Laboratory Module for Differentiating Absorption, Scattering, and Fluorescence in UV-Vis Spectroscopy ***Christopher Jurgenson***[1], *Dongmao Zhang*[2], *Pathum Wathudura*[2], *Huy Pham*[2] [1]*delta state university,* [2]*Mississippi State University*	**Christopher Jurgenson**
189 (Invitee)	**5:51**	**31-4**	Building Brains, Not Just Bodies: The Impact of Applying Constructivist Approaches in Gross Anatomy *Mais Abdelhaq* *University of Mississippi Medical center*	**Mais Abdelhaq**
163	**5:30**	**31-5**	A Student-Led Approach to Building Research Skills Early in Medical Education Through a Medical Student Research Interest Group ***Bailey Lupo***, *Wesley Jameson, Andrew Schwartz, Christian Quinones, Stanley Hoang, Deepak Kumbhare*	**Bailey Lupo**

			Department of Neurosurgery, Louisiana State University Health Sciences Center, Shreveport	
202	**5:45**	**31-6**	Learners as Teachers: Strategies for Peer Teaching from a Constructivist Perspective ***Nathan Tullos*** *University of Mississippi Medical Center*	**Nathan Tullos**



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7:00 PM Subrata Saha Outstanding Speaker Event and Banquet

Room #: UC Ball Room

Moderators: Dr. Ham Benghuzzi and Dr. Michelle Tucci

UT Tyler Welcoming Remarks: Dr. Barbara Haas
Provost, UT Tyler

Distinguished Speaker and Awardee:

Catherine Ambrose, PhD, FORS

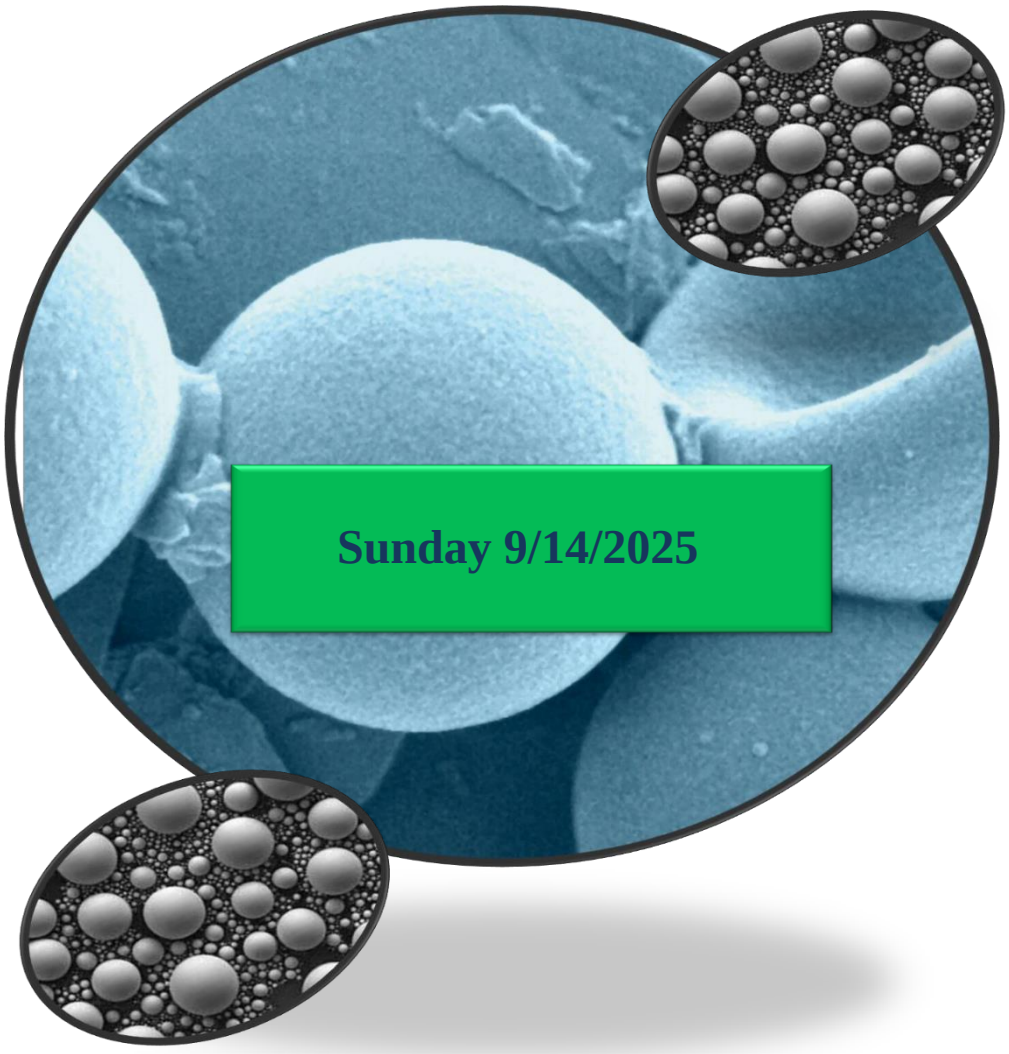
Department of Orthopaedic Surgery, UTHealth Houston, TX

Title: "The Support Within – What I have Learned from Bone Research"



Catherine Ambrose obtained a BS degree cum laude in Mechanical Engineering from Washington University in St. Louis before obtaining a MS in Biomedical Engineering and PhD in Mechanical Engineering from The University of Texas at Austin. Dr. Ambrose is a Professor in the Orthopaedic Surgery Department at McGovern Medical School at UTHealth Houston, where she has been a faculty member since 1992. She holds an adjunct appointment in Biomedical Engineering at Rice University and is a Visiting Professor of Biomedical Engineering at Texas A&M University. Dr. Ambrose runs the Bone Health Laboratories at UTHealth, where the research focus is on biomaterials for infection prevention, drug delivery, and implant design as well as musculoskeletal tissue properties in health and disease. She also runs the Biomechanics Core for the Bone Disease Program of Texas. She has authored more than 80 journal articles and 5 book chapters, presented more than 150 presentations and invited lectures, and has been awarded multiple patents. In addition to research, Dr. Ambrose focuses on educating a wide variety of trainees. She runs the Orthopaedic Surgery Resident Research Program and has been awarded the Dean's Teaching Excellence Award at McGovern Medical School twice. While her work at UTHealth focuses on medical education and research, her appointments at Rice and Texas A&M have allowed her to teach undergraduate Mechanical and Biomedical engineering students. She has mentored 20 undergraduate students, 13 graduate students, 52 medical students, 24 post-doctoral fellows, and more than 100 orthopaedic surgery residents. She is an active member of the American Society for Bone and Mineral Research and the Orthopaedic Research Society, where she has served in leadership positions and was elected as fellow in 2021. She serves the broader biomedical research community as a regular reviewer for NIH, NSF and DOD grants and as an *ad hoc* reviewer for many journals.

END of Saturday Event


Sunday 9/14/2025

Room# WTB 133	**Session 32: Orthopaedics** **Session Chair**: Giovanni Solitro, *Louisiana State University Health Shreveport* **Co-Chair:** Denis DiAngelo, *University of Tennessee Health Science Center*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
30	**8:30**	**32-1**	Prediction of osteogenic differentiation of mesenchymal stromal cells by cell molecular signature ***Qinqin Xu**, Patrick Massey, Shane Barton, Yufeng Dong* *LSU Health-Shreveport*	**Qinqin Xu**
239	**8:45**	**32-2**	Relevance of Medial Wall Defects in Determining Acetabular Strength in Total Hip Arthroplasty: A Pilot Study on Bone Surrogates ***Landyn Froberg**, Steven Kautz, Shane Barton, Giovanni Solitro* *Louisiana State University Health Shreveport*	**Landyn Froberg**
65	**9:00**	**32-3**	Quantification of Elbow Flexion in Overhead Throwing Motion: A Pilot Motion Capture Study on Non-professional Baseball Players ***Anton Pelto**, R. Shane Barton, Giovanni Solitro* *Louisiana State University Health Shreveport*	**Anton Pelton**
235	**9:15**	**32-4**	Use of Additive Manufacturing Tools to Improve the Design Process of Scoliosis Bracing Technology ***CJ Rudolph, D. Kelly, M. Grossman**, DJ DiAngelo* *University of Tennessee Health Science Center*	**Rudolph CJ, Kelly D, Grosman M, DiAngelo**
204	**9:30**	**32-5**	Acromioclavicular Joint Reconstruction: A Biomechanical Comparison of a Novel Hybrid Suture Technique **Ben Chanes**[1], Patrick Massey[1], Arjun Verma[1], Robert Rutz[1], Cameron Vauclin[1], James Robinson[1], Giovanni Solitro[1] [1]LSU Health Shreveport Department of Orthopaedic Surgery	**Ben Chanes**
203	**9:45**	**32-6**	Knee Gapping following Anteromedial Ligament Sectioning: a Kinematic Approach **Austin Thomassen**[1], Lincoln Andre[1], Mason Granger[1], Robert Rutz[1], Giovanni Solitro[1], Patrick Massey[1], Arjun Verma[1] [1]LSU Health Shreveport Department of Orthopaedic Surgery	**Austin Thomassen**

Room# WTB 136	**Session 33: Biomaterials II** **Session Chair**: Lamar Hamil, *University of Mississippi Medical Center* **Co-Chair:** Ken Butler, Jr., *University of Mississippi Medical Center*			
Abstract Number	**Presentation Time**	**Presentation Number**	**Presentation Title**	**Presenting Author**
176	**8:30**	**33-1**	Morphological Analysis of ARIP Cells in Response to Glucagon-Like Peptide-1 Exposure ***Gary Hamil**[1, 2], Hamed Benghuzzi[3], Michelle Tucci[2], Kenneth Butler[2]* *[1]Belhaven University, [2]University of MS Medical Center* *[3]Jackson State University*	**Gary Hamil**
108	**8:45**	**33-2**	Interfacial molecular structure at biomembrane surfaces ***Saranya Pullanchery*** *Texas A & M University*	**Saranya Pullanchery**
39	**9:00**	**33-3**	A Comparative Study of MCF-7 Tumor Cell Growth Using Agarose Seeding, Alginate Mixing, and 3D Bioprinting ***Francisco Perez**, Angel Perez, Shoukath Sulthana, Shawana Tabassum, Santosh Aryal* *The University of Texas at Tyler*	**Francisco Perez**
29	**9:15**	**33-4**	Influence of RGD in Elastin-Based Coatings on the Morphology and Differentiation of 3D Spheroids ***Sheetal Chowdhury**[1], Gene L. Bidwell[2], Joshua S. Speed[3], Amol V. Janorkar[1]* *[1]Department of Biomedical Materials Science University of Mississippi Medical Center, 2500 North State Street, Jackson, MS 39216*	**Sheetal Chowdhury**

			[2]*Department of Neurology University of Mississippi Medical Center, 2500 North State Street, Jackson, MS 39216.* [3]*Department of Physiology and Biophysics, University of Mississippi Medical Center, 2500 North State Street, Jackson, MS 39216*	
80	**9:30**	**33-5**	Magnesium Based Implants Applications in Animal Modules and Clinical Studies: A Narrative Review ***Ali Sulaiman A. Al Yousef*** *National University of Singapore*	**Ali Sulaiman A. Al Yousef**
86	**9:45**	**33-6**	Free Pioglitazone and Echogenic Pioglitazone-Loaded Liposomes Inhibit TGF-Beta-Mediated Conversion of Fibroblasts to Myofibroblasts, a Critical Step in Fibrosis Development ***Melvin Klegerman****, Tao Peng, Sarah Shin, Harry Karmouty-Quintana, David McPherson* *University of Texas Health Science Center at Houston*	**Melvin Klegerman**

Plenary Speaker 2 Room#: WTB 133

10:15-11:15 Host: Dr. Santosh Aryal, PhD. Associate Professor, Pharmaceutical Sciences and Health Outcomes, The University of Texas at Tyler

Presenter: Paolo Decuzzi, PhD,

Laboratory of Nanotechnology for Precision Medicine, Italian Institute of Technology, Genova (Italy) & Stanford University School of Medicine, Stanford (USA) (Visiting Professor)

Title: Engineering Precision Therapies: A Multidisciplinary Approach to Hierarchically-Structured Drug Delivery Systems



Dr. Paolo Decuzzi is a Senior Scientist and Professor of Biomedical Engineering at the Italian Institute of Technology in Genoa, Italy, where he founded the Laboratory of Nanotechnology for Precision Medicine in 2015. He earned an M.Sc. in Mechanical Engineering from the Polytechnic University of Bari, Italy, and completed his Ph.D. in Mechanical Engineering at the University of Naples – Federico II in 2001.

Dr. Decuzzi has a diverse academic and professional background, having served as a Visiting Scholar and Professor at several institutions, including the University of Michigan, Princeton Materials Institute, and Stanford University. He was an Associate Professor at the University of Texas HSC Houston and later served as Professor and Chair of Translational Imaging at Houston Methodist. He currently holds a Visiting Professorship in the Division of Oncology at Stanford Medicine.

Dr. Decuzzi is a Fellow of the Controlled Release Society and a board member of multiple scientific associations, research institutions, and EU review panels. He also advises Academic Biotech Accelerators, including SPARK Stanford, SPARK Europe, and TRAM Stanford. His laboratory focuses on the design, development, and validation of drug delivery systems for treatment and imaging in various diseases, integrating principles from engineering, pharmaceutical, and biomedical sciences. Dr. Decuzzi has authored over 200 papers, holds more than 10 patents and patent applications, and has secured more than $15 million in extramural funding from public and private entities in the U.S. and EU. Notably, 10 of his former trainees currently hold faculty positions at academic institutions in Italy, South Korea, Japan, and USA.

11:15 General Assembly & Student Awards Presentation

See you in New Orleans for 42nd Annual Meeting, September 10-13.2026

Abstracts

Abstracts accepted and presented at the 41st Annual held at the University of Texas at Tyler, September 11-14, 2025, *SBEC Volume 41, 2025*

List of Abstracts presented at the 41st SBEC, 9/11-9/14/2025

1 - REENGINEERED IMMUNOVESICLES IN DRUG DELIVERY

Viswanathan Sundaram, Santosh Aryal

University of Texas at Tyler, Tyler, TX

The nano drug delivery systems facilitate the enhancement of the transportation, effectiveness, and precision of theranostic agents. The common challenges faced by these nanoparticles are nanotoxicity, heterogeneity in biodistribution, off-targeting, and rapid clearance. To address these challenges, the biogenic biomimetic nano-delivery system is an ideal approach because this system acquires natural properties to navigate complex biology. Mostly used biogenic products are extracellular vehicles (EVs) characterized by their innate properties such as proteins, lipids, and genetic elements, acquired from respective mother cells, which have been widely exploited as diagnostic biomarkers to study their respective cellular status. However, heterogeneity in their size, long-term stability, and lower isolation yield limit their use as colloidal nano drug delivery systems. Herein, we put forth the concept of re-engineering where EVs are re-engineered with synthetic liposomes as stable and targeted nanomedicine. In a typical re-engineering, EVs derived from Natural Killer cells, one of the emerging and highly studied cells that naturally seek tumors, were engineered with synthetic liposomes. Tumor-targeting properties of re-engineered nanomedicine were studied using breast cancer cells and tumor-bearing mice models. EVs were collected from cell supernatant using sequential centrifugation, then filtered and assessed for their physical (size, charge, polydispersity, and stability), biological (protein markers) properties, and tumor targeting efficacy using *in vitro* and *in vivo* models. These EVs were nano entities with size ranges from 30 to 170 nm with a zeta potential of -19±5 mV, which were re-engineered with a pre-synthesized 150±5 nm liposome by using mechanical extrusion resulting in the formation of monodispersed hybrid liposomal EVs (HLEVs) with a hydrodynamic diameter of 155±5 nm and zeta potential of -41±1.5 mV. These EVs and HLEVs were found to be rich in protein biomarkers present in NK cells such as CD-63, NKG-2D, NKp-30, and a marker for EVs CD-56, TSG101, and ALIX. *In vitro* and *in vivo* experiments indicated that the biomimetic HLEVs system efficiently targets and distributes in the targeted cancer cells. Considering the importance of proteins in target recognition and mother nature acquired from NK cells, we are highly optimistic that the proposed construct holds promise in targeting tumors to minimize off-target effects in cancer therapy.

2 VERSATILITY OF EXTRACELLULAR VESICLES IN BIOMEDICAL APPLICATIONS

Arunkumar Pitchaimani

Vellore Institute of Technology, India

Nature-designed extracellular vesicles from the mammalian cells plays key roles in various extracellular communications. In particular, the nano-sized Exosomes play a prominent role in cell-cell communication and as well as in genetic exchange. Current Nano research focus is on the utilization of these exosomes for its possible application in drug delivery and biomedical applications. Exosomes derived from Mesenchymal Stem cells (MSc) have functions similar to that of parent MSC cells in repairing tissue damage, inflammatory response, and immune system modulation. More specifically, it shows enhanced brain accumulation potential by crossing the blood-brain barrier (BBB) via systemic injections. Herein, we investigate the role of MSC EXO in delivering therapeutic doxorubicin and PET imaging agents (64Cu) non-invasively for targeted glioblastoma multiform (GBM) therapy. Human adipose-derived MSCs were isolated following the protocols developed at CIMA, University of Navarra (Spain). Further, EXO was isolated from the MSCs via a differential ultracentrifugation. The protein profile was analyzed using western blots and LC-MS (Proteinase-K method). Rhodamine-EXO was used for studying differential cellular uptake in macrophages (RAW 264.7), neuronal cells (Neuro-2A), and brain cancer cells (U87-MG) via confocal and flow cytometry. Doxorubicin was loaded into EXO and its encapsulation efficiencies and release rates using HPLC. Finally, exosomes were also labeled with lipid-DOTA molecules reacted with 64Cu, using fusogenic liposomes. Administration of EXO to mice was realized non-invasively through the nasal cavity in Nu/Nu mice. The exosomes isolated from the hADSCs were spherical in shape with an average diameter of 119 ±7 nm under cryo-EM. The dynamic light scattering analysis showed exosomes with a hydrodynamic diameter of ~130 ± 18 nm and a surface zeta potential of around - 30 ± 2mV. The characteristic functional protein markers exposed to the exosome membrane, CD-9, and CD-81, were identified through western blot and mass spectroscopy analyses. Further, confocal microscopy and flow cytometry analyses showed that significant levels of naïve exosome were taken

up by RAW 264.7, Neuro-2A, and U87-MG cells, as compared to the PK-treated EXO. The radiolabeling efficacy of EXO was found to be ~70% and showed high stability for over 24h. Upon intra-nasal administration, EXO was slowly released from the nasal cavity at the systemic level with peak accumulations in the stomach, intestine, liver, and tumor. The cytotoxicity of DOX-EXO was comparable to that of the free drug. This preliminary work demonstrates that human adipose stem cell-derived exosomes can be efficiently loaded with a chemotherapeutic molecule and a radioactive agent. The bio-distribution of exosomes can be monitored over time using Nuclear Imaging and the therapeutic activity of doxorubicin-loaded exosomes is comparable with the free drug molecule and can be used as a versatile biological nanocarrier for personalized medicine.

3 MAXIMIZING LIPOSOME TUMOR DELIVERY BY HYBRIDIZING WITH TUMOR-DERIVED EXTRACELLULAR VESICLES

Shoukath Sulthana, Dinesh Shrestha, Santosh Aryal

University of Texas at Tyler, Tyler, TX

Extracellular vehicles (EVs) have gained widespread interest due to their potential in the diagnosis and treatment of inflammations, autoimmune diseases, and cancers. EVs are lipidic vesicles comprised of vesicles from endosomal origin called exosomes, microvesicles from membrane shedding, and apoptotic bodies from programmed cell death membrane blebbing that carry complex sets of cargo from their cells of origin, including proteins, lipids, mRNA, and DNA. EVs are rich in integrin proteins that facilitate intrinsic cellular communication to deliver their cargo contents, which can also be used as a biomarker to study respective cellular conditions. Within this background, we hypothesized that when these EVs are hybridized with synthetic liposomes, it would help navigate the hybrid construct in the complex biological environment to find its target. Toward this endeavor, we have hybridized a synthetic liposome with the EVs (herein called LEVs) derived from mouse breast cancer (4T1 tumors) and incorporated a near-infrared fluorescent dye to investigate their potential for cellular targeting and tumor delivery. Using the membrane extrusion, we have successfully hybridized both entities, resulting in the formation of LEVs and characterized for their colloidal properties and stability over a period. While the EVs are broadly dispersed nano and micron-sized vesicles, LEVs were engineered as monodispersed with an average hydrodynamic size of 140±5. Using immuno-blot and ELISA, we monitored and quantified EV-specific protein CD63 and other characteristic proteins such as CD9 and CD81, which were taken as a handle to ensure the reproducibility of EVs and thus LEVs. These LEVs were further challenged with mice bearing orthotopic 4T1 breast tumors and found to be maximizing the LEVs' uptake in tumors and organs like the liver, spleen, and lungs when compared to control PEGylated liposomes in live animal imaging. Likewise, the constructs were capable of finding lung metastasis as observed in ex vivo imaging. We anticipate that this study can open avenues for drug delivery solutions that are superior in target recognition. Please find the detailed results in the following publication: https://pubs.rsc.org/en/content/articlelanding/2024/nr/d4nr02191f/unauth

4 CONVERGENCE OF 3D BIOPRINTING, ORGANOID, AND MPS TECHNOLOGIES IN A PILLAR/PERFUSION PLATE

Moo-Yeal Lee[1], Soo-Yeon Kang[1], Sunil Shrestha[1], Prabha Acharya[1], Vinod Lekkala[1], Mona Zolfaghar[1], NaYoung Choi[1], Minseong Lee[1], Manav Vanga[2], Pranav Joshi[2]

[1]University of North Texas, Denton, TX, [2]Bioprinting Laboratories Inc.

Microfluidic devices have been used to culture primary cells and cell lines in microchannels and chambers to simulate human diseases. Recently, technical advancements have been made to culture human organoids in microfluidic devices to generate “organoid-on-chip.” However, these microfluidic devices have low throughput and are unsuitable for high-throughput organoid culture and analysis. To facilitate dynamic organoid culture in a high-throughput screening (HTS) system, we have developed and commercialized a pillar plate and a complementary perfusion well plate. These plates are highly flexible, user-friendly, and easily combined with conventional 384-well plates to support organoid cultures and multiplexed high-content imaging assays. The scale-up production of organoids, including liver, brain, and intestine, has been demonstrated by “microarray 3D bioprinting” of pluripotent stem cells and passage-able organoids in biomimetic hydrogels on the pillar plate and static and dynamic cultures in the deep well plate and the perfusion plate. The flexible pillar and perfusion well format, connected by microchannels and reservoirs, makes it easy to change growth media for organoid culture without the use of bulky pumps and tubes. Interestingly, the dynamic culture of organoids in the pillar/perfusion plate significantly enhanced the maturity of human organoids. This enhancement is potentially due to the rapid diffusion of growth factors and small molecules necessary for cell differentiation and maturation. The optically clear pillar/perfusion plates allowed *in situ* whole organoid staining and imaging without the need for cryosectioning for predictive organoid-based assays. Additionally, on-chip

cryopreservation of organoids has been demonstrated on the pillar plate for long-term storage and on-demand delivery of organoids. Furthermore, it is compatible with standard 384-well plates and existing HTS equipment, including fluorescence cell imagers and microtiter well plate readers. Thus, we envision that organoids in the pillar/perfusion plate can be used as a safety assessment tool for rapidly screening therapeutic drugs while minimizing the use of animals in drug discovery processes. **Acknowledgements:** This study is supported by the National Institutes of Health (NIEHS R43ES035653, NIDDK UH3DK119982, and NCATS R44TR003491).

5 ANTHRACENE BASED ORGANO-RUTHENIUM ARENE COMPLEXES AS POTENTIAL ANTICANCER AGENTS: SYNTHESIS, CHARACTERIZATION, MECHANISTIC INSIGHTS, AND PROSPECTS FOR LIPOSOMAL NANO DRUG DELIVERY

Neethu K Sankaranarayanan[1], Viswanathan Sundaram[2], Dharmaraj Nallasamy[3]

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Organoruthenium complexes have garnered a significant attention in the research of functional anticancer therapeutic agent for breast cancer. There is an emerging scope for extensive research in this field to demonstrate that ruthenium-based complexes might act as effective anticancer agents, potentially exceeding traditional chemotherapy medications like cisplatin and its derivatives. This research focuses on the production of half-sandwich ruthenium(II) arene complexes with anthracene-based hydrazone ligands as possible anticancer drugs and also optimizing suitability for liposome based nanodrug delivery system. Structural characterisation tests such as XRD, FTIR, and NMR demonstrated that the produced complexes have an octahedral geometry around the core ruthenium metal. The hydrazone ligand, a planar anthracene derivative, coordinates through imine nitrogen and amide oxygen, with a chloride co-ligand acting as a labile ligand, and the remaining coordination sites are occupied by three pairs of electrons from the p-cymene arene ring, maintaining ruthenium in divalent nature. Biomolecular interaction investigations of the complexes with CT-DNA and BSA, examined using spectral methods, revealed binding behaviors comparable with previous reports. Computational analysis further corroborated the structural predictions and biomolecular interactions observed experimentally. The antitumor efficacy of the produced complexes was assessed using *in vitro* breast cancer cell models. Cytotoxicity experiments showed IC_{50} values that indicated considerable cytotoxicity on breast cancer cells. Further mechanistic studies, such as cell migration assays, flow cytometry (Annexin V-FITC and cell cycle assays), fluorescence microscopy (acridine orange/ethidium bromide staining, reactive oxygen species detection, and mitochondrial membrane potential assessment), and molecular gene expression analysis (p53, BAX, Bcl-2, and EGFR), revealed an effective therapeutic response via apoptotic molecular mechanisitic pathways. The findings show that these ruthenium compounds have potential as innovative therapeutic agents for breast cancer. Future studies will explore liposomal drug delivery strategies to enhance the bioavailability, selectivity, and therapeutic efficacy of these organoruthenium complexes, which could offer a new and potential approach to improve targeted cancer therapy.

6 EPIGENETIC REPROGRAMMING OF VITAMIN D RECEPTOR AND LNCRNA NKX2-2AS ATTENUATES OF WNT/B-CATENIN SIGNALING IN BREAST CANCER

Anjali K Ravi

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Breast cancer (BC) is the second leading cause of cancer-related deaths among women worldwide, with 313,959 new cases reported annually. The vitamin D receptor (VDR), a nuclear transcription factor that regulates cell proliferation, differentiation, and apoptosis, is highly silenced in BC. Promoter hypermethylation, a key epigenetic modification, leads to VDR silencing and is recognized as a hallmark of tumorigenesis. Additionally, VDR methylation disrupts VDR-associated long non coding RNAs (lncRNA), which act as tumor suppressors by modulating oncogenic signalling pathways like Wnt/β-catenin through transcriptional interferences. Wnt/β-catenin cascade leads to the nuclear translocation of β-catenin to promote cell proliferation, differentiation, metastasis and multidrug resistance in BC. Therefore, investigating the link between VDR methylation-mediated dysregulation of the lncRNA/Wnt-β-catenin axis may reveal novel biomarkers and therapeutic targets for BC. Hence, this study aims to explore, the role of VDR hypermethylation in regulating lncRNA Nkx2-2as and its impact on Wnt/β-catenin signalling in MCF-7 cells and BC tissues. Using the PROMO tool, VDR binding sites were identified in the Nkx2-2as promoter region, and bisulfite sequencing confirmed VDR promoter methylation in MCF-7 cells and BC tissues. To reverse VDR methylation, MCF-7 cells were first treated with 5-aza-2'-deoxycytidine (5-aza-dC), a DNA

methyltransferase inhibitor, followed by vit-D. The functional role of NKX2-2as was assessed in MCF-7 cells by transfecting cells with Nkx2-2as-siRNA and the Nkx2-2as-pcDNA3.1 vector. The combined treatment of 5-aza-dC and vit-D reversed VDR hypermethylation, inhibiting migration, and cell proliferation by 85% ($p < 0.05$) through enhanced apoptosis. The findings revealed that restoring VDR expression via 5-aza-dC-induced demethylation led to the upregulation of Nkx2-2as. This, in turn, promoted BTG2 and AXIN2-mediated β-catenin degradation, resulting in a 60% ($p < 0.05$) reduction in nuclear β-catenin levels. This resulted in the inhibition of Wnt/β-catenin signaling, as evidenced by the downregulation of its downstream targets (β-catenin, CBP, cyclin D1, TCF-3/4/7). Additionally, apoptotic markers (Bax, caspase-3/6/9) were upregulated, while anti-apoptotic protein Bcl-2 was downregulated, reinforcing tumor-suppression. Nkx2-2as knockdown reversed these effects, promoting tumorigenic characteristics, further emphasizing its crucial role in BC suppression. The study provides novel insights into the epigenetic regulation of VDR/NKX2-2as axis in Wnt/β-catenin signaling, offering a promising therapeutic target for BC treatment.

7 ENHANCED TUMOR DELIVERY OF NANOPARTICLES BY COUPLING WITH NATURAL KILLER CELL DERIVED EXTRACELLULAR VESICULAR

Alisha Upreti, Viswanathan Sundaram, Sriyam Joshi, Santosh Aryal

Department of Pharmaceutical Sciences and Health Outcomes, Ben and Maytee Fisch College of Pharmacy, University of Texas at Tyler, Tyler

Extracellular vesicles are nanosize particulates continuously released by nearly all cell types in their extracellular space, which play a crucial role in intra and intercellular communication. Due to their naturally acquired functional properties guided by the mother cell, EVs have been extensively used as nanomedicine to enhance therapeutic outcomes. However, nanomedicine carries common shortcomings such as nanotoxicity, variable biodistribution, inconsistent tumor accumulation, and rapid systemic clearance that limit their clinical utility. To overcome these challenges, biogenic biomimetic nanodrug delivery systems appear to be a potential alternative, as these systems carry mother nature during biogenesis, for example, extracellular vesicles (EVs). EVs are lipid and protein vesicles that take part in inter and intra-cellular communication and are structurally similar to liposomes. Herein, we hypothesized that when EVs are engineered with synthetic liposomes, they could precisely navigate the liposomes to target destination cells. In this study, EVs isolated from natural killer (NK) cells were reengineered with liposomes, making hybrid liposomal EVs (HLEVs). In a typical procedure, isolated EVs' sizes ranging from 30 to 170 nm were re-engineered with liposomes using mechanical extrusion. The technique produced monodispersed HLEVs with a hydrodynamic diameter of 155 ± 5 nm and a zeta potential of -41 ± 1.5 mV, which is distinct from originally isolated EVs of sizes ranging from 30 to 170 nm. HLEVs retained critical protein markers from NK cells, such as CD63, NKG2D, and NKp30, as well as EV-specific markers like CD56. *In vitro* and *in vivo* experiments revealed that these HLEVs were effectively targeted to breast cancer cells, highlighting their potential in precision drug delivery.

8 MACROPHAGE-DERIVED EXOSOMES COATING ON GOLD NANORODS FOR PHOTOTHERMAL THERAPY

Anavya Jernigan, Shoukath Sulthana, Viswanathan Sundaram, Santosh Aryal

Department of Pharmaceutical Sciences and Health Outcomes, Ben and Maytee Fisch College of Pharmacy, University of Texas at Tyler, Tyler

Gold nanorods (AuNRs) have been explored in photothermal therapy (PT) of cancer due to their strong surface plasmon resonance, which is tunable to a different spectrum of light. PT therapy is a treatment method in which a material is activated with light and releases energy in the form of heat used for therapy. However, the use of AuNRs in biomedical applications is greatly affected by their stability in biological media. Therefore, studies were focused on improving the stability of AuNRs with biocompatible surface functionalization coatings. In the present work, we provide investigations on two different routes that were employed on AuNRs for the effective coating of macrophage-derived extracellular vesicles (MEVs). Towards this end, in our first method, MEVs containing media were collected separately from a cell culture flask and incubated with surfactant-coated AuNRs to obtain MEVs-AuNRs. In our second method, AuNRs were added directly to the macrophage cell culture flask and incubated for 24 h to achieve MEVs-AuNRs. The final MEVs-AuNRs from both methods were purified and characterized via dynamic light scattering (DLS) for the size and surface charge and UV-Vis spectrophotometric analysis for the stability. Spectrophotometric characterization of these MEVs-AuNRs exhibited a near IR effect with maximum absorbance red-shifted to 1000 nm. Next, AuNRs and MEVs-AuNRs aqueous solutions were irradiated with 808 nm near-infrared laser, and the heat evolved was captured using an infrared thermal camera. The observation showed that the suspension temperature

reached 60°C (ΔT=30°C), which is instrumental in the photothermal therapy of cancer.

9 ENHANCING DRUG DELIVERY VIA REENGINEERED CELL-BASED DRUG DELIVERY SYSTEMS

Israel Joshua Santhosh, Macie Kirby, Viswanathan Sundaram, Dinesh Shrestha, Shoukath, Santosh Aryal

Department of Pharmaceutical Sciences and Health Outcomes, Ben and Maytee Fisch College of Pharmacy, University of Texas at Tyler, Tyler

Cells have garnered increased attention as versatile and efficient drug delivery systems owing to their inherent biocompatibility, capability to circumvent immune detection and potential for targeted delivery. This study utilized THP-1 cells (human monocytes) as a model for drug delivery systems and analyzed their interactions with MCF-7 breast cancer cells, specifically with regard to their ability to deliver a drug payload to the cell. THP-1 cells were co-cultured with MCF-7 and imaged using a live-imaging system that would allow monitoring of the cells as immune cell action proceeded. Images were studied to gain a better understanding of the interaction between the cells. THP-1 cells recognized the target cancer cells and were seen attaching to and inducing lysis of the MCF-7 cells, proving their effective targeting and therapy. THP-1 cells were then loaded with a fluorescent (the model drug). Post-loading, cells were imaged to evaluate loading efficiency, and then treated with MCF-7 to establish drug delivery to the target. Transfer of fluorescence was observed which proved proper delivery of the model drug. Additionally, protein assays were run on the lysate of THP-1 and MCF-7 to characterize the pre-interaction state and MCF-7 post-treatment. This allows for a quantitative measurement of the cellular interaction. With the increase in the use of personalized therapies in the treatment plans of many pathologies, this study underscores the promise of immune cells as efficient, cell-based drug delivery systems for targeted cancer therapy, in light of the increasing demand for tailored therapeutic strategies.

10 INFLUENCE OF SURFACE PEG COATING IN LIPOSOMAL DRUG DELIVERY SYSTEM

Troy Dane, Israel Joshua Santhosh, Viswanathan Sundaram, Santosh Aryal

Department of Pharmaceutical Sciences and Health Outcomes, Ben and Maytee Fisch College of Pharmacy, University of Texas at Tyler, Tyler, TX

In clinical settings, anticancer drugs are typically administered in frequent, repeating doses to ensure that the compound concentration remains within the therapeutic window, thus maintaining the intended effect on the body. With recent advancements in drug delivery technologies, sustained-release formulations have been developed for clinical use. These formulations use biocompatible injectable or automated delivery methods to continuously release the drug and keep its concentration at optimal levels. However, lipid nanoparticles (NPs) used in these systems can trigger an immune response within the body, thus leading to their rapid clearance by the immune system. To address this challenge, polyethylene glycol (PEG) chains are often added to the surface of the NPs to reduce their immunogenicity and prolong their circulation time. This project focuses on developing anticancer drug-loaded lipid NPs, specifically using doxorubicin (DOX), with varying PEG chain lengths to determine the most effective formulation for maintaining a consistent drug concentration within cells under *in vitro* conditions. After synthesizing the drug-loaded NPs, their characteristics were analyzed using dynamic light scattering to measure their size and surface charge, which provides insights into their stability. Additionally, drug-loading studies were conducted to determine the efficiency of encapsulating doxorubicin within the NPs. Also, the formulations were tested against cancer cell lines to determine their toxicity. The results of these experiments were used in an effort to identify the optimal DOX-liposome formulation, which will be further explored in our ongoing studies.

11 EXPLORATION OF THE ANTI-CANCER PROPERTIES OF GOLD NANOPARTICLES BIOSYNTHESIZED USING VITIS VINIFERA SEEDS AND AEGLE MARMELOS FRUITS EXTRACTS

Narendhirakannan R.T

Department of Biochemistry, Kongunadu Arts and Science College, G.N. Mills (PO), Coimbatore, Tamil Nadu, India

Site-directed delivery and biological systems may benefit from surface modifications of gold nanoparticles (AuNPs) by surface coatings or capping agents. Nanomaterials have attracted the attention of researchers due to their size and possible uses in a wide range of scientific domains that could benefit humans. Nanoparticles produced by physical, chemical, and biological means have important applications in the physiochemical and biomedical domains. In addition to being a sustainable and environmentally friendly technique of nanotechnology, the biosynthesis of gold nanoparticles (AuNPs) using plant-based methods has drawn attention for its biological uses, especially in cancer therapy. In this study, the biosynthesis of AuNPs is compared utilizing fruit extract from *Aegle marmelos* and seed extract from *Vitis vinifera* as stabilizing and reducing agents. The phytochemicals in the seeds and fruits speed up the creation of AuNPs, which were then identified by TEM,

XRD, and UV-Vis spectroscopy to verify their size, shape, and crystalline nature. Through in vitro research on specific cancer cell lines and in vivo tests utilizing animal models, the anticancer potential of both varieties of AuNPs was assessed. According to the findings, AuNPs made from *Aegle marmelos* showed greater cytotoxicity and antioxidant activity against cancer cells, but AuNPs obtained from *Vitis vinifera* showed improved mitochondrial membrane disruption and apoptosis induction. With different modes of action ascribed to the phytochemicals found in the corresponding plant extracts, in vivo investigations further validated the effectiveness of both types of nanoparticles in inhibiting tumor growth. These results demonstrate the potential of AuNPs mediated by *Vitis vinifera* seeds as a viable anticancer treatment option that provides an economical and environmentally friendly substitute for traditional techniques. These discoveries contribute to the expanding body of knowledge in nanomedicine and provide insight into the development of plant-mediated nanoparticles as innovative remedies for various illnesses.

12 - SIMULTANEOUS DETECTION OF VIBRIO PARAHAEMOLYTICUS tdh and trh GENES IN OYSTERS USING MULTIENZYME ISOTHERMAL RAPID AMPLIFICATION COUPLED WITH LATERAL FLOW DIPSTICK ASSAY

Seongbin Park, Yan Zhang

Mississippi State University, Mississippi State, MS

Vibrio parahaemolyticus is a foodborne pathogen frequently linked to the consumption of contaminated seafood, especially oysters. Although PCR and real-time PCR are commonly used to detect its virulence genes (*tdh* and *trh*), these techniques are not always feasible in resource-limited or field settings. To overcome this limitation, we developed a rapid, sensitive, and specific duplex detection method combining Multienzyme Isothermal Rapid Amplification (MIRA) with Lateral Flow Dipstick (LFD) technology. This assay employed specific primer sets and probes to simultaneously amplify *tdh* and *trh* gene fragments, tagged with 3′-FAM and 5′-Digoxigenin or Biotin during MIRA amplification. The resulting products were detected via antibody-based capture on the LFD strip. The duplex MIRA-LFD assay achieved a detection limit of 100 fg of DNA, 300 CFU per reaction in bacterial culture, and 3,000 CFU per reaction in spiked oyster samples—all within 20 minutes at 40 °C. Importantly, the assay showed no cross-reactivity with nine other *Vibrio* species or 18 foodborne pathogens, confirming its high specificity. Given its speed, simplicity, and sensitivity, this duplex MIRA-LFD assay represents a valuable tool for field-based surveillance of *V. parahaemolyticus* pathogenicity, contributing to public health protection and supporting the seafood industry.

13 -HUMAN-ALLIED AI -- AUTOMATE OR COLLABORATE?

Sriraam Natarajan

University of Texas at Dallas, Dallas, TX

Human-in-the-loop (HIL) systems have emerged as a promising approach for combining the strengths of data-driven machine learning models with the contextual understanding of human experts. However, a deeper look into several of these systems reveals that calling them HIL would be a misnomer, as they are quite the opposite, namely AI-in-the-loop (AI2L) systems, where the human is in control of the system, while the AI is there to support the human. In this talk, I argue that existing evaluation methods often overemphasize the machine (learning) component's performance, neglecting the human expert's critical role. I will motivate the commonalities and differences between these systems and provide several examples from healthcare domains, specifically, that of predicting adverse pregnancy outcomes. I will also explain these systems in the context of neurosymbolic learning and reasoning.

14 - OXYGEN SENSITIVE DRUG RELEASE USING HEMOGLOBIN MICROBUBBLES: A NEW APPROACH TO TARGETING HYPOXIA IN ULTRASOUND-MEDIATED DRUG DELIVERY

Ghazal Rastegar, Mohammad Salman, Shashank Sirsi

University of Texas at Dallas, Dallas, TX

Targeted drug delivery strategies using focused ultrasound (FUS) are gaining prominence in clinical application. FUS offers deep tissue penetration and precise targeting capabilities. The capabilities of FUS in targeted drug delivery are greatly enhanced by the introduction of ultrasound contrast agents (UCAs - also known as microbubbles). This study introduces a novel hypoxia-targeting drug delivery system using hemoglobin microbubbles (HbMBs) conjugated with doxorubicin-loaded liposomes (LDOX). Previously, we reported that HbMBs exhibit significant acoustic response differences between oxygenated and deoxygenated environments due to hemoglobin's conformational changes, which alters the MBs' shell elasticity as well as resonance frequency. In this study, we coated the surface of HBMBs with LDOX to create Lip-HBMB complex and subsequently investigated its drug release at different oxygen partial pressures (pO_2) when exposed to an ultrasound field. Results showed significantly higher drug release at lower oxygen levels, with about 10-times higher release at 5 mmHg pO_2 than 160 mmHg pO_2 at 0.5 W/cm^2 US intensity and 3 MHz

frequency. This highlights Lip-HbMBs' potential for targeted drug delivery to hypoxic tumor regions, marking a significant advancement in focused ultrasound-mediated drug delivery. This study marks the first-ever report of ultrasound-mediated oxygen-sensitive drug uncaging, which holds promise in enhancing FUS specificity and addressing the challenges posed by metastatic cancer.

15 REPURPOSING ATYPICAL ANTIPSYCHOTICS FOR AGGRESSIVE PROSTATE CANCER TREATMENT: INVESTIGATING THEIR ROLE IN CELL PROLIFERATION, MIGRATION, AND ER STRESS

Grace Lee, Berony Geneste, Dalal Dawud, B Pharm, Zakaria Y Abd Elmageed

Department of Biomedical Science, Discipline of Pharmacology, Edward Via College of Osteopathic Medicine, Monroe, LA

Background & Aim: Repurposing atypical antipsychotics for untreated metastatic castration-resistant prostate cancer (mCRPC) therapy is an intriguing area of research. Several studies have shown that some antipsychotic drugs, originally developed to treat psychiatric disorders, exhibit anticancer properties. This study aimed to evaluate atypical antipsychotics anticancer properties for treatment of mCRPC by reducing cellular proliferation and migration while inducing endoplasmic reticulum (ER) stress, with fewer side effects compared to first-generation antipsychotics.

Methods: This study explored the anticancer potential of four atypical antipsychotics: cariprazine, xanomeline, pimavanserin, and iloperidone. Cytotoxic assay was performed to determine the half-maximal inhibitory concentration IC_{50} values of these drugs in mCRPC cells. Colony formation assay was also used to assess the ability of cells to inhibit clonogenic survival. Transwell migration assay was conducted to evaluate the impact of these agents on cell migration. To elucidate the underlying molecular mechanisms, immunoblotting analysis was conducted to evaluate pimavanserin's role in inducing ER stress by quantifying protein markers such as CHOP, BiP, calnexin, PDI, and PERK.

Results

We found that MTT assay identified a wide range of IC_{50} values for the tested antipsychotics, with pimavanserin demonstrating the highest potency in reducing cell viability. Therefore, pimavanserin was selected for further investigation due to its superior efficacy and tolerability profile. Colony formation assay further confirmed pimavanserin's superior ability to impair clonogenic survival. The transwell migration assay revealed significant inhibition of mCRPC cell migration by all four drugs, with pimavanserin exhibiting the strongest effect. These results highlight pimavanserin as a promising candidate for mCRPC therapy. Western blot analysis will validate whether pimavanserin induces ER stress by upregulating markers such as CHOP, BiP, calnexin, PDI, and PERK, which are critical components of the unfolded protein response.

Conclusion: Repurposing atypical antipsychotics offers a promising approach to cancer treatment. Among the tested agents, pimavanserin displayed the most potent effects in reducing mCRPC cell proliferation, clonogenic survival, migration, and positioning it as a leading candidate for further research. Ongoing studies will focus on elucidating the molecular mechanisms underlying its anticancer activity, particularly its capacity to induce ER stress. These results support the potential development of pimavanserin for preclinical and clinical trials.

16 - SIGNAL CROSSWIRE: CROSSTALK IN *S. aureus* SIGNALING SYSTEMS

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Staphylococcus aureus (*S. aureus*) utilizes Two-Component Systems (TCS), molecular signaling units consisting of a Histidine Kinase (HK) coupled with a cognate Response Regulator (RR), to sense and respond to external environmental changes. Signaling in TCS mainly occurs in isolated form. However, bacterial systems have shown signs of variable degrees of crosstalk, where HK phosphorylates non-cognate RR. This crosstalk enhances bacterial survival under stress, like treatment with antimicrobial agents, causing the rise of antibiotic resistance. In this study, we explored the crosstalk between the 16 distinct TCSs in *S. aureus*. We used the Bacterial Adenylate Cyclase-based Two-Hybrid (BACTH) assay to study protein-protein interactions *in vivo* through blue/white screening. The genes of the 16 HKs and the 16 RRs were copied from the *S. aureus* Newman strain genome and ligated into pKNT25 and pUT18 vector plasmids, respectively. Vectors were transformed into the *Escherichia coli* DHM1 strain deficient in adenylate cyclase to identify interactions between the RR and HK. Our results showed various patterns of crosstalk interactions, including one-to-one, one-to-many, and many-to-one, indicating how a highly pathogenic bacteria can assimilate complex responses involving multiple TCSs in response to stress. Insights gained from this research could be used as a catalyst for developing effective agents that target these systems, aiding in the fight against antibiotic-resistant infections.

17 - MODELING TEMPERATURE EFFECTS ON NITRIC OXIDE DYNAMICS AND VASCULAR DIAMETER

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Endothelial dysfunction, an early hallmark of cardiovascular disease, is regulated in part by nitric oxide (NO), a key mediator of vascular tone [1,2]. The relationship between shear stress and NO release is well-studied [3-5]; however, the role of temperature on endothelial responses, such as NO production and vasodilation, remains poorly characterized. In this study, we presented a novel computational model to simulate the combined effects of dynamic interplay among shear stress, Ca^{2+}-mediated NO production, and vessel dilation, and then integrated temperature effects into this framework. We first developed an ODE-based model in which shear stress (derived from blood flow conditions) increases intracellular calcium, resulting in NO production and subsequent vasodilation. We calibrated the model using physiological data [6], setting the baseline vessel diameter at 3,600 µm. Under baseline flow conditions, the resulting shear stress was approximately 2 Pa, increasing to 3.73 Pa with elevated flow. The final shear stress was determined to be 3.7 Pa, reflecting an error of less than 1%. While experimental data report a flow-mediated vasodilation of 10.7% [6], we predicted a dilation of 10.14% under elevated flow conditions using the computational model we developed. Building on the validated model, we extended the simulation by incorporating a coupled PDE-ODE framework to capture the spatial distribution of NO along the vessel and its impact on temperature-dependent changes in diameter. To model microvascular behavior, we adjusted the baseline vessel diameter to 200 µm, representing small arterioles or capillaries. Our temperature-dependent formulation incorporated variations in NO diffusivity, reaction rate constants, and production rates for 37°C, 39°C, 42°C, and 43°C. We observed increased NO levels (21×10^{-5} mol/m³) and vessel dilation (230 µm) at 41°C, followed by reduced NO levels (14×10^{-5} mol/m³) and vessel diameter (216 µm) at 43°C. The findings point to a potential thermal threshold beyond which NO bioavailability decreases, possibly marking the onset of endothelial impairment. Simulation findings highlight temperature as a critical but underexplored parameter in endothelial regulation. In this model, we predicted a 9.15% dilation from 37°C to 42°C, aligning closely with a human study that reported a 9.5% change [7], with an error of only 3.7%. These results emphasize the dual role of temperature in modulating NO-mediated vasodilation and may reflect the initiation of endothelial dysfunction or a disruption in thermoregulatory control. This biothermal modeling approach provides valuable insights into vascular responses under both physiological and elevated thermal conditions. This model sets the foundation for future integration of thermal damage thresholds and cellular stress responses such

18 - SYNERGISTIC IMPACT OF ENZYME MEDIATION AND TRAUMATIC INSULTS ON MORPHO-MECHANICAL PROPERTIES OF JOINT CARTILAGE

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Matrix metalloproteinases (MMPs) and a disintegrin and metalloproteinase with thrombospondin motifs (ADAMTS) significantly impact the biomechanical properties of articular cartilage in osteoarthritis (OA). Mechanical trauma significantly compromises the structural and mechanical integrity of cartilage tissue. High amount of inflammatory enzymes are secreted in the synovial joints after traumatic insults or injury. However, comprehensive understanding of synergistic effect of enzymatic degradation and mechanical trauma has not been widely explored. Moreover, the implication of activity-based preventive strategies is needed for this specific osteoarthritic condition. This study evaluated the mechanics of enzymatically degraded articular cartilage with mechanical trauma synergistically under different physiological conditions. Activity-based preventive mechanisms were also investigated. 10 mm diameter cartilage implants (N=48) with subchondral bones were harvested from 2-3 years of old bovine (n=6) patellofemoral sites of knee joint. The samples were sorted into 4 groups combining healthy or negative control (NC), enzymatically degraded (Enz), samples with mechanical trauma (Trm), samples with combinedly trauma and enzyme degradation (Trm+Enz). Samples were enzymatically treated with MMP-13 (15ng/ml) , MMP-9 (30ng/ml) , and ADAMTS-5 (15ng/ml) and incubated for 44 hours at 37°C and 5% CO_2 to mimic the advanced osteoarthritic conditions. A 1 mm diameter cylindrical through hole was created using biopsy punch at the center of the cartilage to simulate the mechanical insult on the cartilage. In vitro unconfined compression tests were conducted under physiological loading in MACH-1 micromechanical tester. 20% strain was applied for compression test, 5 steps with 3% of strain and 180 sec relaxation time was applied at 0.1% strain rate for stress relaxation test to mimic prolonged standing with alternating load. 1.25% strain was applied at 0.7 Hz frequency to simulate walking activity. Histology and histopathology were conducted using Picrosirius red and Safranin O staining. The degenerated collagen fibrils and

proteoglycans (PGs) in micrographs manifest significant cartilage deterioration by the enzymes. The combined cartilage damage significantly impaired compressive strength and load-bearing capacity and provided the lowest mechanical response across all loading conditions. For compressive modulus, reductions were 88% (Enz), 72% (Trm), and 94% (Trm+Enz) compared with NC (1.2 MPa) . For equilibrium modulus obtained through stress relaxation, values dropped by 52% (Enz), 38% (Trm), and 58% (Trm+Enz) relative to the healthy sample. Moreover, elastic response declined by 89% (Enz), 48% (Trm), and 90% (Trm+Enz), while viscous response showed reductions of 52% (Enz), 6% (Trm), and 54% (Trm+Enz) during dynamic loading. Samples only having mechanical trauma showed better mechanics than enzyme treated cartilage, while combined damage led to the lowest mechanical response but similar viscosity to enzyme-only samples. The synergistic effect of enzyme treatment and trauma provides valuable insights in osteoarthritis management. The study suggests patients affected by this condition should alternate standing loads, avoid prolonged weight-bearing, but consider walking only.

19 - COMPUTATIONAL HOMOGENIZATION OF THE MECHANICS OF DEPTH-DEPENDENT ARTICULAR CARTILAGE UNDER COMPRESSIVE LOADING

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Articular cartilage's depth-dependent mechanical behavior emerges from its multiscale architecture combining collagen fibrils, proteoglycans, and chondrocytes. While microscale models capture this complexity, their computational cost limits tissue-scale analysis. This study implements asymptotic homogenization to derive effective macroscopic properties from a high-fidelity microstructural model, enabling efficient simulations while preserving mechanobiological fidelity. The homogenization framework employs a two-scale asymptotic expansion that separates microscale (cellular/fibrillar) and macroscale (tissue-level) responses. We construct a representative volume element (RVE) based on our validated multi-structural fibril-reinforced poro-hyperelastic (MS-FRPHE) model, incorporating depth-dependent collagen orientation (parallel in superficial, random in middle, and perpendicular in deep zones), zonal cell densities, and strain-dependent permeability.

The governing equations for the poro-hyperelastic solid matrix (neo-Hookean ECM, nonlinear collagen fibrils) and fluid phase (Darcy flow) are expanded across scales, with periodic boundary conditions enforcing continuity. Through computational homogenization of the RVE, we determine effective elasticity, permeability, and viscoelasticity that account for fluid-solid interactions and fibril reorientation during deformation. This approach connects fibril kinematics with homogenized poroelasticity, deriving macroscale constitutive laws through volume averaging of microscale stress and fluid flux while resolving scale separation challenges in fibril-reinforced tissues with hierarchical load transfer.

We hypothesize the homogenized model will predict effective bulk cartilage properties (Young's modulus, permeability) consistent with experimental measurements (7.0±0.4 MPa modulus, 0.2 N equilibrium force) while retaining the MS-FRPHE model's mechanobiological insights, including 85-90% stress attenuation from ECM to chondrocytes. By significantly reducing computational demands compared to full microstructural simulation, this method enables practical investigation of tissue-scale phenomena. This work establishes a mathematically rigorous framework for homogenizing fibril-reinforced poroelastic tissues that bridges microscale mechanisms to macroscale behavior, advancing cartilage biomechanics by enabling efficient simulations of tissue degeneration, repair strategies, and biomimetic scaffold design for osteoarthritis research and regenerative medicine.

20 - MODELING AN AUXETIC HELMET LINER FOR NFL IMPACT SCENARIOS: A FINITE ELEMENT APPROACH

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Mild Traumatic Brain Injury (mTBI), also known as concussion, occurs frequently in American football due to the frequent strikes to players' heads. Several studies have been conducted to understand the aspects of concussion and thereby improving helmet design to reduce risk. Among all the components, a helmet liner plays the most crucial role in absorbing and dissipating impact energy. Traditional liners use foam material, which are limited by their inability to mitigate impact effectively at high strain rates typical of NFL collisions. To address this limitation, an alternative to foam material with enhanced energy absorption capabilities are needed. Auxetic materials, characterized by their negative Poisson's ratio, have shown promising shock absorption properties due to their unique deformation mechanism under dynamic loading. This study explores the mechanical properties of novel auxetic materials as an NFL helmet liner through Finite Element Analysis (FEA) using Abaqus Explicit.

Impact simulations representative of NFL scenarios were conducted on auxetic liners. The liners are constructed with

designed unit cells modeled as a lattice structure. Its auxetic geometry enables lateral expansion under compression, promoting efficient force distribution and enhanced energy dissipation under high-speed impacts. In the preliminary stage, compression simulation was performed on a 15 different 2D and 3D configurations of re-entrant honeycomb and chiral auxetic structures to compare their shock absorption properties. From those simulations, the final structure was selected based on its performance in terms of both energy absorption capacity and relative density. The selected design was further optimized using the Bayesian optimization (BO) method, which enabled efficient tuning of structural parameters to maximize performance. The simulations were validated experimentally using 3D printed samples in a stereolithography (SLA) printer. The current analysis was performed on a 40 × 40 × 40 mm block of auxetic structure, with the thickness chosen to match that of a standard NFL helmet liner. The simulation conditions were designed to replicate impact scenarios relevant to NFL gameplay, with applied velocities in the range of 5-9 m/s and at strain rates between 100 and 600 s^{-1}. The simulation results indicate that the auxetic material exhibits promising mechanical performance with better specific energy absorption (SEA). The proposed liner also significantly reduces the G-force impact to prevent head injury.

This study demonstrates the potential of auxetic structures as effective alternatives to traditional foam liners in NFL helmets. Through FE simulations and experimental validation, the optimized auxetic design exhibited enhanced energy dissipation and significantly lowered transmitted accelerations during impact. These findings highlight that an auxetic liner can help reduce the risk of concussion during professional football impacts. Future work includes extending the preliminary analysis into a more detailed computational simulation using a complete helmet structure. Subsequent experimental validation, such as the NOSCAE drop test, will be performed with the 3D-printed padding to complement the computational findings.

21 - Modeling an Auxetic Helmet Liner for NFL Impact Scenarios: A Finite Element Approach

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Mild Traumatic Brain Injury (mTBI), also known as concussion, occurs frequently in American football due to the frequent strikes to players' heads. Several studies have been conducted to understand the aspects of concussion and thereby improving helmet design to reduce risk. Among all the components, a helmet liner plays the most crucial role in absorbing and dissipating impact energy. Traditional liners use foam material, which are limited by their inability to mitigate impact effectively at high strain rates typical of NFL collisions. To address this limitation, an alternative to foam material with enhanced energy absorption capabilities are needed. Auxetic materials, characterized by their negative Poisson's ratio, have shown promising shock absorption properties due to their unique deformation mechanism under dynamic loading. This study explores the mechanical properties of novel auxetic materials as an NFL helmet liner through Finite Element Analysis (FEA) using Abaqus Explicit.

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22 -DEVELOPMENT OF TARGETED NANOPARTICLES TO ENHANCE DRUG DELIVERY FOR PERIPHERAL ARTERIAL DISEASE TREATMENT

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Introduction: Peripheral arterial disease (PAD) is a progressive condition caused by arterial narrowing in the lower limbs, affecting around 6.5 million Americans, predominantly older adults. Current therapies, including bypass surgery, stents, gene therapy, and stem cell treatments, are limited by high restenosis rates and inadequate drug retention. To overcome these barriers, we developed biocompatible, targeted nanoparticles that leverage molecules upregulated in PAD tissues to enhance cellular uptake, increase drug bioavailability, and improve therapeutic effectiveness.

Materials and Methods: Poly(lactic-co-glycolic acid) (PLGA) nanoparticles (NPs) were synthesized by using a standard emulsion technique and conjugated to targeting moiety through covalent coupling. Sizing, charge, and polydispersity (PDI) of these NPs were quantified using Dynamic Light Scattering (DLS). The *in vitro* binding properties of the targeting NPs were investigated via cellular uptake studies in static and flow conditions. After NPs' treatment, activated cells were washed and imaged under fluorescent microscope. Afterward, cells were lysed to evaluate NPs' fluorescent signals using a spectrophotometer. The biodistribution of targeting NPs *in vivo* was studied using the PAD mouse models. The ischemic hindlimb injury was induced by ligating the left femoral artery and its branches, while the right hindlimb was left untreated as a control. The NPs were administered intravenously (IV) via the tail vein. NPs' accumulation *in vivo* and *ex vivo* was assessed using the Kodak *in vivo* imaging System. The tissues were further harvested to evaluate the amount of these NPs at PAD legs and different organs.

Results and Discussions: We had successfully engineered and incorporated targeting moiety to PLGA NPs, which had average diameters of around 200 nm, surface charges of around -25 mV, and were highly stable up to 3 days. Our binding studies of targeting system *in vitro* showed higher cellular uptake at least more than 50% in static condition in the first 10 minutes and highest under flow conditions in activated cells. Our *in vivo*, *ex vivo*, and muscle homogenization data demonstrated significantly higher NPs accumulation around 2-fold in ischemic sites in our targeting NPs compared to a control. The NPs distribution in ischemic muscles observed under fluorescent microscope also supported the promising capability of our targeting system via high localization at ischemic tissues.

Conclusion: Our studies conducted *in vitro* and *in vivo* have demonstrated that NPs specifically targeted activated cells under flow conditions and ischemic hindlimb legs in mice, thus offering the potential for site specific drug delivery in PADs. Further *in vitro* studies will evaluate nanoparticle uptake pathways, cytocompatibility, and hemocompatibility, while *in vivo* toxicity will be assessed through body weight, hematocrit, and key biomarkers across organs.

23 -ADVANCED SHAPE MEMORY POLYMERS: AN ADDITIVE MANUFACTURING APPROACH FOR NEXT GENERATION BIOMATERIALS.

Melanie Ecker, Raj Kumar Pittala, Neha Pramod Davange

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Advancements in polymer science and additive manufacturing are converging to achieve smart materials for biomedical applications. This study explores the development of novel shape memory polymers (SMPs) engineered specifically to use as biomedical heat shrink tubing applications, capable of sealing tissues or organs post-surgery or injury. By combining the tunable chemistry of thiol-ene/acrylate systems with the design flexibility of stereolithographic (SLA) 3D printing, we aim to create biocompatible, shape memory polymers that respond to physiological conditions through water-induced plasticization. The polymer system resin is developed using 1,3,5-triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione (TATATO), Trimethylolpropanetris(3-mercaptopropionate) (TMTMP), and Polyethylene Glycol Diacrylate (PEGDA, M_n 700), along with Diphenyl(2,4,6-trimethylbenzoyl)phosphine oxide (TPO) as a photoinitiator and Sudan I for pigmentation. PEGDA was introduced to increase the polymer's stretchability and to modulate its thermomechanical behavior by enhancing free volume, facilitating a lower glass transition temperature (T_g) in aqueous environments.

Fabrication of biomedical heat shrink tubes was carried out using a Phrozen Sonic Mini 8KS SLA printer equipped with a 405 nm LCD light source. The resin formulation was optimized for layer thickness and exposure parameters, followed by post-processing steps including isopropyl alcohol washing and UV curing. Dynamic mechanical analysis (DMA) demonstrated a significant shift in T_g under submersion, affirming the polymer's ability to plasticize at body temperature. Biocompatibility, an essential feature for clinical viability, was evaluated using MTT cytotoxicity assays with ISO 10993-5 compliant L929 fibroblast cells.

All tested compositions-maintained cell viabilities above the 70% threshold, confirming non-cytotoxicity. Shape memory properties were assessed qualitatively and quantitatively to ensure the printed polymers still retain their shape memory properties.

This research represents a significant step toward the integration of advanced polymer chemistry and additive manufacturing to produce next-generation biomedical devices. Future work will focus on optimizing mechanical durability, enhancing biodegradability, and scaling fabrication for pre-clinical evaluation. Ultimately, this study paves the way for innovative medical solutions that merge engineering precision with biological adaptability.

24 - GRAPHENE-COPPER NANOCOMPOSITE INHIBITS hACE-2 PREVENTING CELLULAR INTERACTION OF SARS-CoV CORONAVIRUSES

Sohel H. Quazi[1,3] *Shoukath Sulthana*[1¶], *Abeera Bhatti*[2¶], *Elza Mathew*[2], *Natasha Gaudreult*[2*], *Robert DeLong*[4*], *Santosh Aryal*[1*]

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This study demonstrates the copper nanocomposite-induced inhibition of human angiotensin I-converting enzyme-2 (hACE-2) by complex stabilization through enzyme nanocomposite formation. The hACE-2 functions as a cell surface receptor through which Spike (S) protein of the SARS-CoV and SARS-CoV-2 coronaviruses enters the host cell more specifically into the heart, kidneys, and lungs. ACE-2 enzyme regulation is a potential therapeutic strategy in hypertension and cardiovascular disease, diabetes, lung injury, and fibrotic disorders, this receptor is hence of great pharmacologic importance. Towards this endeavor, synthesized copper nanocomposites were tested for their potential of inhibiting hACE-2 activities. Following wet chemical synthesis, Cu/CuO nanoparticles and graphene-Copper (GO-Cu) complexes were synthesized and characterized for their chemical integrity. Cu/CuO formed well-dispersed clusters of 390±100 nm, which when complexed with hACE-2 enzyme exhibit larger clusters of 506±56 nm. The formation of the Cu/CuO and hACE-2 enzyme complex was monitored by analyzing the zeta potential, which reflects the surface charge distribution of the complex. A negatively charged Cu/CuO nanocomposite nearly becomes neutral when complexed with hACE-2 further assuring the complex formation thereby inactivating the enzyme as the enzyme is not available to target binding. Similarly, carboxylate functionalized graphene was complexed with copper and studied its inhibitory effect. Each step in GO-Cu composite formation was monitored by characterizing its surface electrical properties resulting in a decrease in its zeta potential and conductivity when complexed with copper. Interaction of the nanocomposites with hACE-2 was confirmed by 2D-FDS and gel electrophoresis analysis. GO-Cu was a rapid and efficacious inhibitor compared to Cu-CuO, especially at lower concentrations (2 mg/ml). Considering the environmental friendliness of copper and graphene and their use in industries as surface coating materials, we anticipate these composites have promising future applications for inhibiting productive viral receptor interactions and may be useful as the surface coating of packing materials, biomedical devices, and high contact areas to minimize pathogen transmission. Details of the study can be found inhttps://pubs.rsc.org/-en/content/articlehtml/2023/na/d3na00468f

25 - TOXICITY AND INFLAMMATORY RESPONSE OF CANNABIDIOL (CBD) IN LUNG EPITHELIAL CELLS

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The medical and recreational use of cannabidiol (CBD), a biologically active, non-psychoactive compound derived from cannabis, has increased in recent years. CBD is available in various dosage forms and is commonly used in vaping devices (CBD pens). Inhalation rapidly increases CBD levels in the bloodstream, leading to immediate effects. However, exposure to high concentrations of inhaled CBD may have cytotoxic effects on lung epithelial cells, which remain poorly understood.This study aimed to evaluate CBD toxicity and its effects on key inflammatory mediators in lung epithelial cells. Human lung epithelial cells (A549-CCL-185™) were cultured and treated with CBD. Cell viability was assessed using the CyQUANT MTT Assay, while the expression of TNF-α and NF-κB was analyzed by RT-qPCR. CBD exposure up to 6 µg/mL for 18 hours did not affect cell viability; however, at 6 µg/mL for 24 hours, a reduction in viability was observed. At 10 µg/mL, cell viability decreased at 12, 18, and 24 hours. Preliminary data showed that a 4-hour treatment significantly reduced the expression of TNF-α, NF-κB, and IL-1β compared to the control. However, prolonged exposure (18 hours) led to a significant increase in the expression of these inflammatory mediators. These findings suggest that CBD modulates the inflammatory response in

a time-dependent manner, initially exerting anti-inflammatory effects, but promoting a pro-inflammatory response with extended exposure. Ongoing studies aim to further elucidate the underlying mechanisms of CBD's effects on inflammatory pathways in lung epithelial cells.

26 - THE ROLE OF ASTROCYTES IN ACTIVE AND SILENT SYNAPSE FORMATION

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Maintaining a balance between active (AMPA receptor containing) and silent (AMPA receptor lacking) neuronal synapses is a pivotal milestone in glutamatergic synapse development. Aberrant silent synapse development has been implicated in neurodevelopmental disorders and drug addiction, while decreased synapse number and activity is prevalent in aging and neurodegeneration. Astrocytes, a major class of non-neuronal brain cells, produce factors that regulate both active and silent synapses, yet the intracellular neuronal pathways are not well defined. Our previous work identified members of the neuronal LAR family receptor protein tyrosine phosphatases (LAR-RPTPs) as necessary for active and silent synapse formation mediated by astrocyte-secreted proteins glypican 4 (GPC4) and thrombospondin 1 (TSP1) respectively. To identify the cellular pathways downstream of LAR-RPTPs-GPC4 and TSP1 interactions we utilized a phosphoproteomic strategy and identified glycogen synthase kinase 3β (GSK3β) as candidate to mediate active synapse formation. GSK3β canonical mechanism of action, and the one most commonly targeted with drugs, is its inhibition through serine phosphorylation (pS9). Our proteomic and immunofluorescence data show GSK3β activation through increased tyrosine phosphorylation (pY216) in neurons treated with GPC4, while GSK3β pY216 signal is decreased in brain sections from GPC4 KO mice. These findings suggest that active synapse formation requires activated GSK3β. Conversely, we show increased GSK3β inhibition in neurons treated with the silent synapse-promoting factor TSP1, suggesting that in response to astrocytic proteins, GSK3β functions as a molecular switch promoting silent or active synapses. This study will lead to a profound understanding of GSK3β activity at the synapse, and identify detailed cellular pathways promoting specific synapse types, laying the groundwork for future translational work.

27 - HIGH-FIDELITY 3D TRANSIENT BLOOD FLOW SIMULATION IN PATIENT-SPECIFIC VASCULAR MODELS USING AN IN-HOUSE CFD SOLVER

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This work aims to extend the capabilities of our in-house computational fluid dynamics (CFD) solver to accurately simulate blood flow dynamics. The solver is based on the pressure correction (projection) method for incompressible Navier-Stokes equations. A distinctive feature of our approach is a non-traditional staggered mesh layout, where velocity components are located at cell centers and a pressure-related auxiliary variable is defined at cell vertices. The governing equations are discretized and solved using a hybrid finite volume/finite element method: the momentum equations are addressed via a matrix-free, implicit, time-accurate, cell-centered finite volume scheme, while the pressure Poisson equation is handled using a node-based continuous Galerkin finite element method. Post-solution corrections are applied to both the velocity and pressure fields to ensure incompressibility and accurate wall pressure representation.

The solver is parallelized through domain decomposition and leverages the Message Passing Interface (MPI) for high-performance computing on large-scale 3D simulations.

To validate and demonstrate the solver's capabilities, we employ several vascular models obtained from https://vascularmodel.org/dataset.html. The simulation pipeline includes vascular geometry modeling, mesh generation, specification of boundary conditions, solver execution, and post-processing for visualization and analysis. Physiologically realistic boundary conditions are imposed, including pulsatile velocity inlets and pressure outlets. Blood is assumed to behave as a laminar fluid. The study compares wall shear stress, wall pressure, streamline patterns, and vorticity for both Newtonian and multiple non-Newtonian models.

Ultimately, our goal is to enhance the predictive fidelity of our CFD solver in simulating hemodynamic behavior, thereby supporting researchers and clinicians in understanding how morphological changes influence blood flow in cardiovascular studies.

28 - ROLES OF STRIATAL NEURONAL AND SYNAPTIC PLASTICITY AND DOPAMINE D2R ISOFORMS IN DRUG-INDUCED DYSKINESIA

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The basal ganglia circuitry including the striatum is involved in the pathophysiology of Parkinson's disease and drug-induced dyskinesia. Modulating the activity of striatal neurons by the dopamine D2 receptor (D2R) can greatly

impact motor control and movement disorders. Alternative splicing of the D2R gene generates two isoforms: D2 long form (D2L) and D2 short form (D2S). We assessed whether changes in the expression levels of D2L and D2S would alter striatal neuronal and synaptic activity and drug-induced abnormal involuntary movements (AIMs), which is a model for dyskinesia-like behavior. We found that in dopamine D2L knockout (KO) mice (lacking D2L but still expressing D2S), the D2R agonist quinpirole altered neuronal excitability in the striatum. Additionally, the frequency of inhibitory postsynaptic currents was reduced in striatal cholinergic interneurons (ChIs) in D2L KO mice compared to wild-type (WT) mice. Furthermore, D2L deficiency resulted in reduced dendritic spine density in ChIs in D2L KO mice, suggesting that D2L activation plays a role in the formation and/or maintenance of dendritic spines of ChIs. We also showed that D2L KO mice displayed markedly enhanced dyskinesia-like behavior in response to chronic treatment of L-dopa or quinpirole compared to WT mice, suggesting that D2S upregulation may facilitate dyskinesia-like behavior induced by dopamine agonists. Our findings reveal new molecular and cellular mechanisms for causing ChIs abnormality observed in Parkinson's disease and suggest new factors contributing to the pathophysiology of L-dopa-induced dyskinesia.

29 - INFLUENCE OF RGD IN ELASTIN-BASED COATINGS ON THE MORPHOLOGY AND DIFFERENTIATION OF 3D SPHEROIDS

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In vitro adipose cell culture models must replicate progressive adiposity by facilitating gradual intracellular fat accumulation in 3D clusters of adipocytes over extended periods. In previous studies, we cultured human adipose-derived stem cells as 3D spheroids on elastin-like polypeptide-polyethyleneimine (ELP-PEI) coatings, including those with Arginine-Glycine-Aspartic Acid (RGD) residues. We found that incorporating three RGD residues at the C-terminus of ELP significantly enhanced spheroid retention. In this study, we qualitatively and quantitatively evaluate the effects of the RGD-containing ELP-PEI coating on morphology, differentiation, and maturation. ELP conjugated with RGD was produced using genetically modified *Escherichia coli* bacteria modified to express ELP-$(RGD)_3$ via suspension culture. The ELP-$(RGD)_3$ molecules were conjugated with PEI (MW= 800 Da) as described before. ELP-RGD-PEI conjugates were characterized by o-phthalaldehyde (OPA) assay for evaluating the percentage of conjugation. 5 mg/mL of 5 mol% ELP-RGD-PEI conjugates and 95 mol% ELP were adsorbed onto 24-well tissue culture polystyrene (TCPS) plates by placing 200 µL solution in each well. 3T3-L1 mouse pre-osteoblasts (50,000 cells/well) were seeded on the coated plates and allowed to form spheroids for 3 days (D3). The spheroids were differentiated along the adipogenic lineage for 3 days (M0) and matured for 2 weeks (M14). The spheroids were imaged using an Olympus IX-81 optical microscope, and the images were analyzed using ImageJ. To confirm adipogenic differentiation, we measured the triglyceride content using TG assay and the adiponectin and PPAR-gamma mRNA expression using RT-PCR. One-way ANOVA, test for homogeneity of variance, Bonferroni's *post-hoc* test, and Games-Howell *post-hoc*test were performed. Results with $p \leq 0.05$ were deemed statistically significant. The average spheroid size increased on ELP-PEI coating as they were differentiated and matured along the adipogenic lineage. The average spheroid diameter was observed to be 58.4 ± 2.6 mm on D3, 75.3 ± 3.8 mm on M0, 88.5 ± 6.7 mm on M7, 104.2 ± 8.3 mm on M14. Triglyceride content of spheroids cultured on the ELP-PEI coating increased as the cells were differentiated and matured along the adipogenic lineage. However, increase in the triglyceride content for spheroids cultured on the ELP-$(RGD)_3$-PEI coating was less pronounced. The PPAR-gamma and adiponectin gene expression in spheroids cultured on the ELP-PEI coating increased with differentiation and maturation of cells along the adipogenic lineage. However, such increase for spheroids cultured on the ELP-$(RGD)_3$-PEI coating was less pronounced. We observed the dynamic nature of cell-surface interactions of adipocytes with the elastin-based coatings containing RGD. Spheroids cultured on the ELP-PEI coating showed greater differentiation and maturation along the adipogenic lineage compared to those cultured on the ELP-$(RGD)_3$-PEI coating.

30 - PREDICTION OF OSTEOGENIC DIFFERENTIATION OF MESENCHYMAL STROMAL CELLS BY CELL MOLECULAR SIGNATURE

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Bone marrow mesenchymal stromal/stem cells (MSCs) transplantation is a promising therapy for bone regeneration as their ability to differentiate into bone forming osteoblastic cells. However, the clinical outcome of the capacity for bone formation is variable. To identify a subset of the MSCs that has high osteoblastic differentiation

capacity is critical for clinical applications. By using single cell sequencing technology, we compared the molecular signature of expanded mesenchymal stromal cells (MSCs) derived from different patient bone marrow mononuclear cells as well as their capacity of osteoblastic differentiation in this study. We observed all samples expressed higher gene transcript levels that are involved in early osteogenesis /chondrogenesis/ adipogenesis (COL1A1, CEBPP, CD44, TGFB1, ENG, THY1, NT5E). The differential expressed genes (DEGs) related to cell cycles (UBE2C, CCNB1, E2F1, AURKB, CDC20, MCM7, CDKN2D) enriched in clusters in all 5 different samples suggested that cell proliferation related gene plays important role in MSCs maintenances and differentiation. Interestingly, the samples with highest osteogenic differentiation ability have a dramatically increasing in gene (CD74, HGF, HLA-DRA, LIF, IBSP, BGLAP, VEGFA) expression. These results suggest that some genes such as CD74, HGF could be marker genes for the prediction of the outcomes after MSC transplantation, and application of these marker gene positive MSCs will improve bone regeneration in clinical therapy.

31 - STRATIFYING THERAPEUTIC ENOXAPARIN DOSE IN MORBIDLY OBESE PATIENTS BY BMI CLASS: A RETROSPECTIVE COHORT STUDY

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Background Enoxaparin is a low-molecular weight heparin (LMWH) commonly used for treatment of venous thromboembolism and acute coronary syndromes. The recommended dose for these conditions is weight-based (1 mg/kg) and doesn't require dose-capping. However, previous studies have shown that in those with a body mass index (BMI)>40 kg/m2 , this dose results in supratherapeutic levels. Objective This study investigated enoxaparin dosing in morbidly obese patients with a goal of identifying a dose with the greatest chance of producing favorable anti-factor Xa (anti-Xa) levels. Methods This retrospective cohort study by electronic chart review was used to record data of patients who received enoxaparin with anti-Xa level monitoring between 2012 and 2017. The primary outcome was the enoxaparin dose that results in a therapeutic anti-Xa level (0.5-1.0 IU/mL) among three BMI groups. Secondary outcomes were bleeding and thromboembolic events. Results Two hundred forty-one patients were included in the study, and 132 achieved a therapeutic dose. For those with a BMI of 40-50 kg/m2 , the median therapeutic dose was 0.97 mg/kg every 12 h. In subjects with a BMI of 50-60 kg/m2 , the median therapeutic dose was 0.70 mg/kg. Finally, the median therapeutic dose for subjects with a BMI over 60 kg/m2 was 0.71 mg/kg. In all three groups, 53-65% of patients had a supratherapeutic anti-Xa level while less than 10% had a subtherapeutic level. Relatively few patients (4.1%) experienced major bleeding and only one thromboembolic event was reported. Conclusion Standard dosing of enoxaparin in morbidly obese patients will most likely lead to supratherapeutic anti-Xa levels and thus further investigation is warranted to better determine appropriate dosing

32 - REAL-TIME VARROA MITE DETECTION IN HONEYBEES USING LIGHTWEIGHT IMAGE CLASSIFICATION MODELS ON EDGE DEVICES

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The global decline in honeybee populations—essential pollinators in agricultural ecosystems—has been significantly accelerated by infestations of *Varroa destructor* mites. Traditional detection methods, such as manual inspection, sugar rolls, and sticky boards, are labor-intensive, time-consuming, and potentially disruptive to the health of bee colonies. To address the growing need for efficient, low-cost, and non-invasive monitoring, this study proposes a lightweight, real-time image classification system deployable on resource-constrained hardware, enabling early detection of *Varroa* infestations in honeybee hives.

We introduce a practical solution that combines a Raspberry Pi microcontroller with camera modules, trained using Google's MediaPipe Model Maker. The system leverages a publicly available dataset of 13,509 annotated images—3,947 showing infestation and 9,562 healthy—where mite locations were manually identified to support precise classification. Multiple neural network architectures were evaluated, including MobileNet-V2, EfficientNet-Lite0, EfficientNet-Lite2, and EfficientNet-Lite4. MobileNet-V2 emerged as the optimal choice, achieving 80% validation accuracy with a compact model size of only 8.68 MB—balancing performance with computational efficiency.

To ensure feasible field deployment, the model was trained using transfer learning techniques on Google Colab with GPU acceleration. Data augmentation strategies such as horizontal flipping and random rotation were employed to enhance generalization and reduce overfitting. The final model was converted into TensorFlow Lite format for compatibility with embedded devices like the ESP32, allowing real-time, in-hive detection without requiring cloud processing or constant internet connectivity. This

makes the system highly suitable for use in rural or remote apiary environments.

This approach addresses key limitations of prior methods. In contrast to resource-intensive object detection models like SSD or YOLO—or systems reliant on expensive TPU accelerators—our model is optimized for low-power edge-computing devices. Unlike smartphone-based detection tools that require user interaction, this system enables continuous, autonomous monitoring, supporting proactive hive health management.

By integrating lightweight machine learning models with accessible hardware platforms such as Raspberry Pi and ESP32, this work advances the field of precision apiculture. It offers a scalable and cost-effective solution for real-time hive monitoring, empowering beekeepers to detect infestations early and take timely action to prevent colony collapse.

Future work will explore enhancements in detection accuracy through multi-stage models, incorporation of higher-resolution images, and integration with a comprehensive hive monitoring system that includes sensors for temperature, humidity, and acoustics.

This research underscores the potential of combining artificial intelligence, edge computing, and open-source tools to address ecological challenges—making data-driven, precision beekeeping accessible to both commercial and small-scale beekeepers alike.

Beyond apiculture, the model architecture and framework developed here can be adapted for real-time image classification in other domains such as agriculture, environmental monitoring, wildlife tracking, and low-cost IoT diagnostics for resource-limited settings.

33 - EFFECT OF NANOMATERIAL SURFACE MORPHOLOGY ON THE SENSING PERFORMANCE OF AGRICULTURAL VOC SENSORS: A REVIEW

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Volatile organic compounds (VOC) are gaseous substances released from agricultural activities. They are mainly carbon-based gases such as isoprene, chloropicrin, methane, acetone, methanol, and formaldehyde etc. These compounds are important biomarkers commonly used to determine the plant productivity, pest infestation, disease control, soil health and freshness in a farm environment. Therefore, the timely detection of these biomarkers has been an important issue in the agricultural industry.

The application of electrochemical gas sensors in VOC detection has become the primary choice in this field due to their high sensitivity, rapid response, low power consumption, miniaturization, and portability. However, the poor selectivity, stability, and limited detection range remains the main challenges of this sensor. With the advancement of nanotechnology, the application of different nanomaterials in electrochemical gas sensors has increased. Nanomaterials with varied surface morphologies are modulating the sensing mechanisms and enhancing the performance day by day.

This review mainly focuses on the effect of surface morphology on the performance of electrochemical VOC sensors. Surface morphology has distinct features such as surface roughness, aspect ratio, porosity, and crystallographic facets. These features significantly influence the sensing properties of materials including gas adsorption, electron transfer kinetics, and overall sensor selectivity and sensitivity. Morphological tuning enables precise control over the number and type of active sites available for gas-solid interactions, diffusion pathways, and signal transduction processes.

This review discusses four different types of nanomaterials morphologies: zero-dimensional (0D) nanoparticles, one-dimensional (1D) nanorods and nanowires, two-dimensional (2D) nanosheets, and three dimensional (3D) hierarchical or porous architectures. Each class has distinct surface areas, active site distribution and electron transport mechanism which eventually exhibits distinct gas sensing behavior. For instance, 1D morphologies have directional charge transport behavior which improve response times, whereas 3D morphologies have maximum surface-to-volume ratio and enhanced gas diffusion.

This review also covers the most commonly used nanomaterials, such as metal oxides (e.g., TiO_2, ZnO, SnO_2 etc.), carbon-based materials (e.g., graphene, carbon nanotubes), and composite systems as well as their morphology-performance relationship. Reproducibility of the morphology remains a significant challenge. To address this, this review discusses different synthesis methods such as, sol-gel technique, hydrothermal process, template assisted growth, chemical vapor deposition, physical vapor deposition, and electrospinning, highlighting advances in overcoming this issue.

Other challenges, such as fabrication scalability, long-term operational stability under humid conditions, and sensor selectivity in complex gas mixtures, are also discussed. Strategies such as facet engineering, core-shell structures, and machine learning-guided material design are explored as potential solution to these challenges.

In a nutshell, this review discusses the significance of surface morphology in the development of electrochemical VOC sensors, which have significant demand in the agricultural industry. This work intends to serve as a valuable reference for researchers in the field of VOC gas sensors.

34 - SEVERELY POLARIZED EXTRACELLULAR ACIDITY IN TUMORS

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pH is a fundamental parameter regulating molecular and physiological processes. In cancer therapy, acidic pH has long been exploited as a key target for drug delivery systems, including nanomedicine. Traditionally, extracellular pH in normal tissues is recognized as tightly controlled and neutral, while tumor extracellular pH has been measured at 6.3-6.9, and endosomal/lysosomal pH at 4.5-6.8. However, these measurements have primarily relied on techniques with limited spatial resolution. Using ultra pH-sensitive (UPS) nanoparticle probes with transistor-like activation behavior and subcellular spatial resolution, we discovered Severely Polarized Extracellular Acidification Regions (SPEAR)—focal extracellular zones in tumors where cancer cells directionally secrete protons and lactate *via* monocarboxylate transporters, resulting in localized pH values below 5.3. This acidity is significantly more severe than previously recognized and represents a new spatially confined biophysical feature of tumors. Furthermore, we demonstrated the clinical feasibility and advantages of targeting SPEAR for tumor-specific imaging using UPS-based nanoprobes in cancer patients. This work provides a new spatial and mechanistic understanding of tumor acidity and suggests that a lower pH threshold (e.g., pH <5.4) should be adopted in the development of pH-activatable nanotherapeutics to maximize tumor specificity and minimize off-target effects.

35 - ROLE OF KIF4A in FXa INDUCED MYOFIBROBLAST DIFFERENTIATION OF HUMAN PLEURAL MESOTHELIAL CELLS

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Pleural injuries can break down the organization of pleural surface and this can lead to remodeling of pleura and results in fibrosis (PF). Pleural remodeling is characterized by proliferation of myofibroblasts that express alpha smooth muscle actin (a-SMA), extracellular matrix proteins such as collagen and fibronectin. Recent studies revealed that these myofibroblasts are primarily due to mesenchymal transition of pleural mesothelial cells (PMCs) (MesoMT). It has been known that various external stimuli such as TGF-b, thrombin and factor Xa (FXa) induce MesoMT. Our laboratory recently revealed that each stimulant produces unique phenotype of myofibroblasts derived from PMCs. We found that FXa induces migratory phenotype of myofibroblasts. Our RNA sequencing data shows that KIF4A expression is up regulated by FXa stimulation and down regulated by MyoCD gene knockdown. KIF4A is over expressed in mouse disease model and human IPF patients. Since our results show that FXa activates through MyoCD a group of genes that are not up regulated by TGFb or thrombin. Since Kinesin superfamily protein 4A (KIF4A) expression is largely and uniquely up regulated by FXa stimulation, we hypothesize that KIF4A plays a role in migratory phenotype of FXa induced myofibroblasts derived from PMCs. KIF4 is a microtubule-based motor protein which hydrolyses ATP to produce energy which is utilized in transporting cellular cargo. This motor protein has been thought to be involved in various cancers, but underlying mechanisms are unknown. We study the effect of FXa and MyoCD on the mRNA and protein expression of KIF4A and the effect of knockdown of KIF4A on the myofibroblast phenotypic changes. Since the unique phenotype changes of myofibroblasts such as migratory and contractile phenotypes are closely related to the cytoskeletal remodeling, we study the role of KIF4A on cytoskeletal remodeling.

36 - NOVEL HYBRID SMALL-MOLECULES AND TOPICAL DRUG DELIVERY STRATEGIES FOR TREATING OPTIC NEUROPATHY

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Background: Ischemia and reperfusion-induced oxidative stress and inflammation are hallmark features of glaucomatous and diabetic optic neuropathy. The damage extends beyond the retina to the brain, particularly affecting the optic nerve and visual cortex. Current therapies for retinal neurodegeneration and choroidal neovascularization rely on intravitreal injections, which can be painful, and frequent injections may lead to inflammation, infections, and edema in the eye. We have designed, synthesized, and evaluated a series of novel nitric oxide donors and antioxidant hybrid compounds with blood-retina/brain permeable physicochemical characteristics. We have demonstrated the efficacy of the lead compounds in protecting retinal neurons in in vitro and in vivo mouse models of ocular neurodegeneration through eye drop administration.

Objectives: To investigate the biodistribution of our novel compound SA-2, formulated as nanosuspension eye drops, in mouse and rabbit eyes. Rabbit eyes are relatively similar in size and anatomy to human eyes. Here, we will quantify the drug concentration in the eye tissues' anterior segments (cornea, aqueous humor, lens) and posterior segments (vitreous humor, retina, choroid, sclera, optic nerve).

Methods: The synthesis, purification, and characterization of the compound SA-2 were conducted using organic chemical synthesis, liquid chromatography, nuclear magnetic resonance spectroscopy, and mass spectrometry to obtain the final products in >95% purity. The fabrication and characterization of SA-2 encapsulation in Poly (D, L-lactic-co-glycolic acid) (PLGA) nanoparticles were conducted similarly to our previously described protocol, with modifications to obtain >80% drug loading and size < 300nm. An HLPC/LC/MS method was developed to detect SA-2 quantitatively in MS. The nanosuspension eye drop was dosed to either mouse (C57BL/6J, 10-12 weeks, n = 12 eyes/time point) or rabbit eyes (Dutch belted, 8-10 months, n = 4 eyes/time point) as a single eye drop. The animals were sacrificed at 1h, 6-8h, and 24h post-dosing, eyes were enucleated, dissected, and tissues and fluids were collected and stored in PBS at -80°C. Tissues were homogenized, processed, extracted with acetonitrile, and dried using a Vacufuge. The dried slurry was later reconstituted, filtered, and injected into an Agilent LC-MS to quantify the drug concentrations.

Results: In mouse eyes, the 2% SA-2NP (437µg of SA-2) nanoformulations provided therapeutic doses in both anterior and posterior segments in the range of 0.7-2.63 picomolar pM/mg of tissues after 1h. In rabbit eyes, as expected, higher concentration of SA-2 was observed in the cornea at 1h (47.5 pM/mg) and 16.0 pM/mg at 6h. In contrast, SA-2 concentration increased from 1.24 pM/mg to 8.20 pM/mg in the retina from 1-6h time points. Additionally, we detected ~2-fold higher concentration of SA-2 in VH (14.47pM/mg) than in retina, suggesting that the PLGA encapsulated nanoformulation forms a depot in VH, exhibiting a slow release profile, which may reduce the need for frequent intravitreal dosing.

Conclusions: The results support our hypothesis that these novel nanosuspension formulations achieve therapeutic bioavailability through topical eyedrop administration. Ongoing studies evaluate detailed pharmacokinetics and bioavailability in the optic nerve and visual cortex.

37 -NOVEL DUAL IMAGING NANOPARTICLES TO STIMULATE THERAPEUTIC ANGIOGENESIS FOR THE TREATMENT OF PERIPHERAL ARTERIAL DISEASES

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Poor treatment management for peripheral artery disease (PAD) leads to high morbidity and mortality rates. This work developed novel biodegradable dual-modal imaging nanoparticles (DINPs), precisely delivering EpoR plasmids (pEpoR) at ischemic sites, while simultaneously accomplishing location tracking and monitoring of therapeutic efficacy. Fluorescent imaging of DINPs validated cellular uptake while photoacoustic imaging further confirmed localization to the disease region post-injection and enabled monitoring of vascular oxygenation as an effective tool to gauge treatment efficacy and responsively tune therapeutic dosing. Encapsulated pEpoR was effectively delivered in vitro, acting to protect stressed Human Muscle Microvascular Endothelial Cells and facilitating tube formation on Matrigel. In vivo, pEpoR DINPs enhanced angiogenesis, restored physical capability, and mitigated muscle necrosis, rescuing affected limbs from amputation. DINPs' intrinsic imaging properties in vitro and in vivo combined with localized pEpoR delivery markedly enhanced growth of blood vessels and muscle recovery, validating them as a superior platform for treatment of PAD with potential for further applications as trackable and targeted therapeutic vectors.

38 - ANALYZING INTRAOPERATIVE NEUROMONITORING SIGNALS USING ADVANCED SIGNAL PROCESSING AND MACHINE LEARNING

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Introduction: Electrophysiology and neuromodulation have become integral components of modern spine surgery, where intraoperative neuromonitoring (IONM) supports the prevention of neurological injury. However, IONM signals are influenced by a wide range of patient-specific and perioperative factors, complicating interpretation. Machine learning (ML), combined with advanced signal processing, offers the potential to automate the analysis of complex IONM data and enhance intraoperative decision-making. This study investigates the impact of preoperative medications, intraoperative pharmacologic agents, BMI,

smoking status, and vital signs on IONM signal integrity using ML-based approaches to better understand the physiologic modulation of neuromonitoring signals.

Methods: A prospective study of spine surgery cases with IONM data was performed. Preoperative medications (opioids, anxiolytics, antidepressants, gabapentinoids) within 90 days of surgery were obtained from a state prescription drug monitoring program. Additional collected variables included patient BMI, smoking history, baseline vital signs, comorbidities, and intraoperative medication administration. IONM signal features were extracted and processed using advanced electrophysiologic signal processing techniques. These features were used to train ML algorithms to model the relationship between patient factors and IONM signal changes.

Results: Advanced signal processing and ML algorithms were used to analyze the effects of preoperative and intraoperative factors on baseline IONM signals. Further refinement with comprehensive feature sets is ongoing.

Conclusion: This study highlights the potential of combining electrophysiologic signal processing with ML techniques to better understand and predict modulation of IONM signals during spine surgery. Although early models based on limited input data demonstrated moderate predictive capacity, incorporating more granular clinical details, patient-specific variables, and precise physiologic parameters may improve model robustness. Future research integrating comprehensive neuromodulatory factors could lead to ML-driven platforms that support real-time IONM interpretation and intraoperative neuromodulation strategies

39 - A COMPARATIVE STUDY OF MCF-7 TUMOR CELL GROWTH USING AGAROSE SEEDING, ALGINATE MIXING, AND 3D BIOPRINTING

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Cancer remains a major global health challenge, causing nearly 10 million deaths in 2022, with new cases projected to reach 35 million by 2050. This alarming rise highlights the urgent need for innovative research models and treatment strategies. While traditional animal studies have advanced cancer biology, they are limited by high costs, long timelines, ethical concerns, and poor translation to human clinical outcomes. Differences in metabolism, lifespan, and immune responses between mice and humans often cause discrepancies in drug development and therapy success. Tissue engineering offers a promising alternative by creating three-dimensional (3D) tumor models that better replicate the human tumor microenvironment. These models capture the complex cellular interactions, biochemical gradients, and heterogeneity seen in human cancers, providing more physiologically relevant platforms for studying tumor growth, invasion, and therapeutic response. Advances in 3D bioprinting further enhance tissue engineering by allowing precise spatial arrangement of cells and extracellular matrix components. Hydrogels, due to their biocompatibility, tunable mechanical properties, and ability to mimic native tissue environments, have emerged as ideal materials for 3D cancer modeling. Together, tissue engineering, 3D bioprinting, and hydrogel technologies offer a transformative approach to cancer research, improving model accuracy while addressing ethical and translational challenges of traditional methods.

This study aimed to engineer a biomimetic 3D hydrogel platform to cultivate human breast cancer MCF-7 cells, addressing the shortcomings of animal models and traditional two-dimensional cultures. The MCF-7 cell line, derived from human breast adenocarcinoma, offers well-characterized genetic and phenotypic profiles suitable for in vitro cancer modeling. By cultivating these cells in a 3D hydrogel environment, we aimed to recreate key features of the tumor microenvironment, facilitating the study of tumor growth, invasion, and drug response in a controlled and reproducible system. Three methods were investigated for growing MCF-7 cells in 3D scaffolds: surface seeding on agarose (Method One), mixing cells directly with agarose (Method Two), and 3D bioprinting using sodium alginate and the FRESH (Freeform Reversible Embedding of Suspended Hydrogels) technique (Method Three). The results demonstrated that the 3D-printed hydrogel scaffold facilitated cell-cell interactions and facilitated the development of a tumor microenvironment. Furthermore, quantitative analysis using ImageJ revealed that Method 3, a FRESH printing method, provided the most suitable environment for the proliferation and growth of MCF- 7 cells into tumoroids, allowing the study of tumor growth, invasion, and response to therapy in a controlled and reproducible manner. This system, as evidenced by qualitative microscopy images and quantitative ImageJ analysis, highlights its promise for applications in drug screening, therapeutic planning, and personalized medicine. Further optimization and characterization of this platform could lead to more accurate and reliable in vitro cancer models, reducing reliance on animal studies and advancing cancer therapy approaches.

40 - EXPLORING ZEBRAFISH HEART CONTRACTION WITH LIGHT FIELD MICROSCOPY

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Cardiovascular diseases remain the principal cause of global mortality, owing in part to an incomplete elucidation of the cellular mechanisms that underlie cardiac dysfunction, which in turn constrains the development of effective diagnostic and therapeutic modalities. In this study, an integrative imaging framework was devised that couples light-field detection with single-cell tracking to obtain real-time, three-dimensional volumetric data from the zebrafish (Danio rerio) heart—an experimental model exhibiting structural to the human myocardium and pulsating at 120-180 beats per minute. The custom light-field microscopy platform attains volumetric acquisition at 200 Hz and delivers lateral and axial resolutions of 5.02 ± 0.54 μm and 9.02 ± 1.11 μm, respectively, throughout the entire cardiac chamber via an estimated-maximized-smoothed deconvolution algorithm. Thereafter, deep learning-based cell-tracking algorithms are applied to quantify hemodynamic and contractile parameters—such as cellular displacement and velocity—and to perform interactive volumetric trajectory analyses of individual cardiomyocytes from end-systole through end-diastole. This methodology enables high-throughput, longitudinal visualization and quantification of ventricular contractile dynamics at single-cell resolution over multiple cardiac cycles, thereby furnishing a robust platform for mechanistic studies of intercellular interactions in both physiological and pathological contexts.

41 - RESOLUTION ENHANCEMENT BY SUBPIXEL SAMPLING AND COMPUTATIONAL REGISTRATION AND RECONSTRUCTION

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In far-field optical microscopy, image resolution and field-of-view (FOV) often exhibit an inverse relationship due to constraints imposed by digital sampling, sensor pixel size, and system magnification. This study presents a novel approach that mitigates this tradeoff through a spatial shifting mechanism combined with a reconstruction algorithm. The proposed method involves subpixel incremental shifts of the sample, followed by image registration using phase correlation, and subsequent integration via a shift-and-add technique. Notably, this approach does not require specialized optical components beyond those typically found in commercially available or custom-built microscope systems. Experimental results demonstrate a substantial improvement in spatial resolution—approximately 42%—while preserving the system's FOV, thereby achieving more than a twofold enhancement in the space-bandwidth product.

42 - VOLUMETRIC IMAGING TO RECAPITULATE CARDIAC MICROSTRUCTURE AND CONTRACTILE FUNCTION

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Advanced understanding of cardiac structure and function is crucial for uncovering the underlying mechanism of injury and arrhythmias. To explore cues to structural and functional abnormalities in extensively established animal models, we have developed optical imaging and computational methods tailored to investigate intact hearts of zebrafish and rodents at cellular resolution. Our cardiac light-field microscopy allows us to capture instantaneous dynamics such as calcium transients, irregular contraction, and blood flow at 200 volumes per second in zebrafish larvae. To improve the spatial resolution and enable the study of rodent models, we have customized two light-sheet imaging systems. One system is empowered by the retrospective synchronization and machine learning for the study of contractile function and focal myocardial mechanics from end-systole to end-diastole, while the other integrates tissue clearing and axially scanning approaches for the exploration of ventricular trabeculation and myocardial compaction. These methods aim to overcome the trade-off in spatial resolution, imaging speed, field of view across the atria and ventricles with minimal photo-damage and maximal penetration depth, enabling long-term investigation of cardiac development and regenerative processes. To further interpret the large volume of datasets, we have customized a virtual reality-based platform for interactive image analysis. Collectively, our multi-scale strategy has opened up new landscapes for exploring the cardiac micro-structure and contractile function, both in health and disease.

43 - PEPTOID-CONJUGATED GOLD NANORODS FOR TARGETED HYPERTHERMIA OF CANCER STEM CELLS

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Cancer stem cells (CSCs) are a subpopulation of pluripotent cells capable of giving rise to the diverse cell types comprising both solid and hematologic malignancies.

Although CSCs constitute a minor fraction of the total tumor cell population, they are critically implicated in tumor initiation, metastasis, and recurrence. Furthermore, CSCs are highly resistant to conventional chemotherapy and radiotherapy, and emerging evidence suggests that such treatments may inadvertently enrich the CSC population. Consequently, the development of therapeutics specifically targeting CSCs represents a promising strategy for achieving durable cancer remission. To this end, we have developed peptoid-conjugated gold nanorods (AuNR-CL-1-19-1) designed to selectively target CSCs. AuNR-CL-1-19-1 exhibits excellent chemical and physical stability and demonstrates preferential binding to aldehyde dehydrogenase (ALDH)-positive CSCs over non-CSC populations within breast cancer cells. Notably, upon irradiation with a 532 nm nanosecond-pulsed laser, AuNR-CL-1-19-1 treatment resulted in a significant reduction in the ALDH-positive CSC population, accompanied by decreased expression of key CSC-associated transcription factors, including Klf4, c-Myc, Sox2, and Nanog. Future studies aim to evaluate the in vivo applicability and therapeutic potential of this novel nanotherapeutic platform.

44 - IMMUNOTHERAPY AT THE SPEED OF SOUND: ULTRASOUND-GUIDED STRATEGIES FOR TARGETED IMMUNE ACTIVATION

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The recent success of immune checkpoint inhibitors (ICIs) for the treatment of refractory metastatic melanoma, lung and renal cell carcinoma has provided optimism that similar approaches could be generalized to a broader range of cancers. However, a large subset of cancer patients do not respond to ICIs as they harbor immunologically silent (or "cold") tumors. Recent studies have shown that activation of the innate immune sensor cyclic GMP-AMP synthase-stimulator of interferon genes (cGAS-STING) promotes antigen presentation and T-cell activation, thus transforming cold tumors into immunologically responsive (or "hot") tumors. However, because STING is a cytosolic protein and a key mediator of inflammation, activation of STING needs to be specific to antigen-presenting cells (APCs) in tumor tissues.

To address this technical challenge and meet the clinical need, a technology termed MUSIC (Microbubble-assisted Ultrasound-guided Immunotherapy of Cancer) was developed. MUSIC is a novel, first-in-class non-immunogenic platform for delivery of diverse therapeutic payloads that utilizes gas-filled microbubbles (MBs) conjugated with APC-targeting antibodies and cationic biopolymers. This platform was first used to provide spatiotemporal control to activate STING by delivering the STING activator cGAMP to APCs in a desired location under image-guidance.

Preliminary results show that, upon exposure to ultrasound, MUSIC produces robust STING activation and type I IFN responses in APCs and more efficiently primes antigen-specific CD4+ and CD8+ T cells in vitro. These immune stimulatory effects of MUSIC directly translated into antitumor responses in vivo, as MUSIC generated antitumor effects against syngeneic orthotopic primary (EO771) and metastatic (4T1) murine breast cancer models. Both models showed dramatic antitumor responses following local treatment of the primary tumor. Specifically, 6 out of 10 EO771 tumor-bearing animals were tumor-free after 50 days, while 4T1 tumor-bearing mice exhibited a significant decrease of the systemic disease burden including lung metastases. Successful establishment of systemic immune memory following MUSIC treatments was also confirmed as mice rejected tumor cells upon re-challenge. No obvious toxicity was observed in these studies.

The efficacy of MUSIC was further demonstrated in two syngeneic murine melanoma models (B16-F10 and D4M), with 100% of D4M-tumor bearing animals and 50% of B16-tumor bearing animals achieving complete remission when treated with a combination of MUSIC and ICIs.

To address the reduced responsiveness in B16-F10 tumors, we are now developing a complementary platform termed AMPING (Antibody-Microbubble-mediated Peptide-based Immune primiNG). AMPING enables ultrasound-guided, APC-targeted delivery of tumor-associated peptide antigens to enhance cross-presentation and support priming of tumor-specific T cells. This approach allows us to overcome antigen scarcity or immune ignorance in resistant tumor models and to further potentiate the immune-stimulatory effects of MUSIC. Together, these technologies offer a promising strategy for multiplexed, spatiotemporally controlled immunotherapy tailored to overcome the limitations of immune cold tumors.

45 - POLYPEPTIDE-BASED FUNCTIONALIZATION OF QUARTZ CRYSTAL MICROBALANCE SENSORS: ADVANCING ANALYTICAL SENSITIVITY AND SELECTIVITY

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Many sensors for detecting contaminants (e.g., gases, pollutants, pH, and biological compounds), struggle with performance and specificity in complex solution environments. To address this, we designed a flexible and selective sensor using elastin-like polypeptides (ELP) and Quartz Crystal Microbalance (QCM) chips. ELP's reversible phase transition behavior was exploited to enhance sensor sensitivity under diverse conditions.

QCM chips were functionalized through a multi-step process, including APTES silanization, HMDI reaction, and grafting ELPs onto the surface. Selected ELPs were [VPGVG]40 and [VPGVG]120. Surface modifications were analyzed using FTIR, ellipsometry, and water contact angle measurements. The modified sensors were tested for reactivity under varying pH (5-8) and salinity (0.01-0.3 M) conditions using QCM-D.

FTIR analysis confirmed successful ELP grafting, showing amide peaks characteristic of ELP. Ellipsometry indicated incremental increases in thickness with each modification. Water contact angle measurements validated changes in surface hydrophobicity in each respective layer, confirming that each layer has a unique chemical identity. QCM-D testing demonstrated the sensor's responsiveness to variations in salinity, with frequency shifts confirming its salt sensitivity.

This work successfully grafted ELP onto QCM chips, achieving enhanced sensitivity to salt variations while maintaining structural integrity. Future studies will explore broader applications and the sensitivity thresholds of the sensor.

Acknowledgements
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46 - IONIC LIQUID-COATED NANOPARTICLES FOR CNS DELIVERY OF ANTIRETROVIRAL THERAPY IN HIV

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In the central nervous system (CNS), the primary long-lived HIV reservoirs are microglial cells (brain-resident macrophages) and, to a lesser extent, astrocytes. These CNS reservoirs remain a major barrier to viral eradication because they are effectively shielded from many antiretroviral therapies (ART). Most ART drugs cross the blood-brain barrier (BBB) inefficiently—often less than 10% of plasma drug levels penetrate into brain parenchyma. The BBB's tight junctions and efflux transporters further limit drug entry, leading to subtherapeutic concentrations in brain HIV target cells. There is a critical biomedical need for innovative delivery strategies to ferry ART across the BBB and into these CNS reservoirs.

To address this need, we developed a nanoparticle-based delivery platform using ionic liquid (IL)-coated poly (lactic-co-glycolic acid) (PLGA) nanoparticles to enhance ART transport into the brain. The choline fatty acid-base IL coating imparts a "cell-hitchhiking" capability by adsorbing onto circulating blood cells. In particular, IL-coated NPs bind preferentially to peripheral monocytes in the bloodstream without inducing phagocytic uptake. This mechanism allows the NPs to evade rapid clearance by phagocytic immune cells and exploit monocyte trafficking to cross the BBB. In vivo studies in mice demonstrated that IL-coated NPs can successfully accumulate in CNS tissue: after systemic administration, IL-coated NPs were detected at the cervical spinal cord and brain base within 24 hours. Within the brain, these NPs showed strong localization to microglia, with 66.23% of recovered nanoparticle signal co-localized with microglial cells, more than 12-fold higher than the NPs without IL-coating. Complementary *in vitro* experiments using human microglia cultures confirmed enhanced uptake of IL-coated NPs versus uncoated NPs, consistent with active targeting of the intended reservoir cells.

Finally, we evaluated therapeutic efficacy by loading a combination of antiretroviral drugs (e.g., lamivudine, abacavir, and dolutegravir) into the IL-coated NPs. In an HIV-infected human microglial cell model, the IL-NP delivered ART significantly suppressed viral replication (p24-based assay) over 10 days, comparable to standard free-drug treatment. These results underscore the potential of IL-coated nanocarriers to overcome the BBB and deliver ART directly to HIV-infected glial cells. This IL-enabled nanoparticle strategy represents a promising advance for treating neuroHIV, with broader implications for improving CNS drug delivery in other neurological diseases.

47 - VIRUS-LIKE PARTICLES AS TARGETED DRUG DELIVERY NANOCARRIERS FOR TRIPLE-NEGATIVE BREAST CANCER

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Triple-negative breast cancer (TNBC) is an aggressive and therapeutically challenging subtype of breast cancer,

characterized by the lack of estrogen receptors (ER), progesterone receptors (PR), and human epidermal growth factor receptor 2 (HER2). The lack of these molecular targets renders conventional endocrine and HER2-directed therapies ineffective, necessitating the development of novel treatment strategies. Here, we report the development of a targeted drug delivery nanocarrier comprising poly-glycinated LC129-8, a TNBC-selective peptoid, covalently conjugated to HK97 virus-like particles (VLPs) engineered with a C-terminal LPETG motif for site-specific sortase-mediated ligation. This system exploits the structural integrity and high loading capacity of the VLP scaffold, combined with the selective binding affinity of LC129-8, to facilitate the targeted delivery of chemotherapeutic agents to TNBC cells. The sortase-mediated conjugation was systematically optimized by varying the ratios of peptoid to sortase, with conjugation efficiency assessed by dot blot analysis. Additionally, the interior of the HK97 VLPs was functionalized with aldoxorubicin, a doxorubicin derivative featuring an acid-labile linker, to enable pH-responsive drug release. Release studies demonstrated sustained release of doxorubicin under acidic conditions, mimicking the tumor microenvironment. Ongoing work includes quantitative analysis of peptoid conjugation density, mass spectrometric characterization of the VLP-peptoid conjugates, and in vitro evaluation of the specificity, selectivity, and therapeutic efficacy of the nanocarrier. We anticipate that this targeted delivery nanocarrier system will enable the administration of high concentrations of chemotherapeutic agents selectively to TNBC cells, thereby enhancing apoptosis while minimizing off-target toxicity.

48 - INVESTIGATING METHODS FOR SMALL MOLECULE POLYMERIZATION INSIDE THE HK97 VIRUS-LIKE PARTICLE

Cailey Rocquemore, Alexis Osborn, Dustin Patterson

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Virus-like particles (VLPs) are non-infectious nanomaterials derived from viruses. VLPs are of interest for applications in biomedicine including drug delivery due to their unique size, 10-100 nm, ease of production, and well characterized structural information that allows extensive redesign and modification of the VLP. The HK97 VLP is derived from the HK97 bacteriophage first isolated from pig dung in Hong Kong. The HK97 VLP is made up of 420 copies of the GP5 coat protein which forms an initial 56 nm spherical nanoparticle, called Prohead I, that can subsequently be transformed to additional morphologies (Head II is fully mature). The Prohead I HK97 VLP form is particularly interesting because it has been shown to have limited cellular uptake in mammalian cells unless first modified on the exterior, making it an ideal candidate for drug delivery. The focus of this research is to develop approaches for exploiting internal cysteine residue thiols as sites for directing polymerization reactions that aim to increase the internal loading capability and capacity of the HK97 VLP for small molecule loading. Past experiments have shown the internal cysteine mutation, S305C, of the GP5 protein allows attachment of individual molecules without altering the HK97 VLP. Using polymer chemistry, we look to increase the potential to utilize the full internal space of the HK97 VLP for greater loading for applications in drug delivery.

49 - THE NOVEL ROLE OF DEDICATOR OF CYTOKINESIS 2 IN CARDIOVASCULAR DISEASES

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Cardiovascular diseases (CVDs) are the leading cause of death globally, which include coronary heart disease, cerebrovascular disease, rheumatic heart disease and other conditions. Atherosclerosis, the major risk factor of coronary artery disease and stroke, is the primary cause of death particularly in the developed world. The inflammatory responses of endothelial cells (ECs), the adhesion and infiltration of monocytes, and the transformation of macrophages into foam cells are vital events in the development of atherosclerosis. However, the molecular mechanisms regulating these processes in atherosclerosis remain largely unknown. Our preliminary findings support that dedicator of cytokinesis 2 (DOCK2) is a novel regulator for EC inflammation and macrophage activation in atherogenesis. DOCK2 is essential for the expression of pro-inflammatory cytokines and adhesion molecules in ECs. In vivo, DOCK2 knockout (DOCK2-/-) in mice significantly attenuates the lesion size, macrophage infiltration, and the expression of adhesion molecules and pro-inflammatory cytokines. These findings uncover a novel role of DOCK2 in atherosclerosis development. Abdominal aortic aneurysm (AAA) is a lethal degenerative vascular disease that affects mostly the elder population with a high mortality rate (>80%) upon rupture. Aortic wall inflammation and the subsequent degradation of extracellular matrix (ECM) especially the elastin breakage are the determining factors for AAA development. Vascular smooth muscle cell (VSMC) inflammatory phenotypic changes with downregulated VSMC-specific contractile markers and increased levels of monocyte chemoattractant protein-1 (MCP-1) and metalloproteinases (MMPs) underly some of the major pathological findings in AAA. Our group previously demonstrate that DOCK2 mediates VSMC phenotype and vascular remodeling after vessel injury. However, little is known about the impact of DOCK2 on

inflammatory SMC phenotypic modulation during AAA development. We found that DOCK2 was robustly upregulated in aneurysm lesions of mice and human AAA patients. DOCK2-/- significantly attenuated the Ang II-induced AAA formation in mice along with reduction of MCP-1 and MMP expression and activity. Accordingly, the elastin fragmentation was significantly attenuated by DOCK2 deficiency. Moreover, DOCK2-/- decreased the prevalence and severity of aneurysm formation as well as the elastin degradation observed in the topic elastase model. Our data indicate that DOCK2 is a novel regulator for AAA formation by mediating vascular inflammation and elastin degradation.

50 - PHOSPHOLIPID TRANSPORTERS—WHY HAVE THREE?

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The gram-negative outer membrane acts as a barrier protecting the cell from chemical and physical stress. The long-standing mystery of phospholipid transport to the outer membrane has been recent relieved by the discovery of three phospholipid transporters in *E. coli* K-12, YhdP, TamB, and YdbH. Evidence suggests these proteins provide hydrophobic channels for the diffusion of phospholipids between the membranes with YhdP and TamB playing major roles. However, YhdP and TamB have several quite different phenotypes suggesting distinct functions in phospholipid transport. In this work, we investigated a unique cold sensitivity phenotype of a double mutant of *yhdP* and a major regulator of fatty acid synthesis and degradation. Our genetic investigations that have led us to be able to differentiate the roles of YhdP and TamB, based on substrate specificity, with the cold sensitivity suppressed by decreasing phospholipid saturation or by certain mutations affecting cardiolipin synthesis. Our ongoing work suggests that TamB has differing affinity for its transport substrates that may contribute to this substrate specificity. Overall, our data clarifies the roles of the individual transporters, suggesting a rationale for the redundancy in this system.

51 - DOCK2 MEDIATES MACROPHAGE OXIDATIVE STRESS IN OBESITY ASSOCIATED LUNG INJURY

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Obesity is defined as the excessive fat accumulation that imposes many health concerns. Recent study showed that lung inflammatory status and oxidative stress are modulated by high-fat diet induced obesity. Dedicator of cytokinesis 2 (DOCK2) was reported to mediate a proinflammatory phenotype of lung fibroblasts to elicit lung inflammation in a chronic high-fat high-fructose (HFHF) diet-induced obesity. While oxidative stress is closely related to lung injury, the role of DOCK2 in mediating macrophage oxidative stress in the context of diet-induced obesity remains elusive. We found that DOCK2 knockout reduced palmitic acid (PA)-induced oxidative stress in bone marrow-derived macrophages (BMDMs). The induction of iNOS, MCP-1, and IL-6 by PA observed in wild-type (WT) BMDMs was not found in DOCK2 knockout BMDMs in the presence of PA. DOCK2 knockout also attenuated the overall oxidative stress levels. Further, the knockdown of DOCK2 using siRNA in WT BDMDs also significantly decreased the expression of these pro-oxidative/proinflammatory markers. Further mechanistic study showed that DOCK2 knockout attenuated the activation of NF-κB and Rac1, which likely account for the inhibition of PA-induced oxidative stress in BMDMs. Further, *in vivo* study showed that DOCK2 knockout reduced the expression of oxidative stress markers in the lungs of mice fed a chronic HFHF diet. Together, the study demonstrated a critical role of DOCK2 in mediating macrophage-derived oxidative stress that potentially induces lung injury associated with obesity.

52 - TARGETING BROMODOMAIN-CONTAINING PROTEIN 4 IN ABDOMINAL AORTIC ANEURYSM

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Cardiovascular disease is the leading cause of global death. Among these, atherosclerosis is a chronic inflammatory disease characterized by the formation of plaques in vessels that constrict blood flow. This results in abnormal hemodynamic forces that stress the smooth muscle cells (SMCs) in the vessel wall. The SMCs will switch roles and release matrix-remodeling enzymes, along with signals, to promote a mild increase in vessel size and maintain the lumen area. Excessive remodeling results in medial thinning and the breakdown of components essential to the structural integrity of the vessel, leading to the formation of an abdominal aortic aneurysm (AAA), which is typically

undetected until it ruptures, with a mortality rate of 80%. Research has demonstrated a correlation between this response and transcription regulation by Bromodomain-containing protein 4 (BRD4), however, the underlying mechanisms for these deregulated immune responses remain unclear. We hypothesized that BRD4 regulates AAA formation by modulating the inflammatory phenotypic state of SMCs. BRD4 was induced in human aortic SMCs (HuAoSMCs) by pro-inflammatory inducers, TNF-α, IL-1β, or Angiotensin II, in a dose-dependent manner. Intriguingly, the knockdown of BRD4 significantly decreased the induction of MCP-1 by TNF-α in HuAoSMCs. Inhibition of BRD4 with a small-molecular inhibitor (JQ1) or degrader (ARV-825) also attenuated TNF-α-induced expression of MCP-1 and MMP-9, suggesting that BRD4 is implicated in the proinflammatory phenotypic changes of HuAoSMCs. Mechanistically, JQ1/ARV-825 blunted the TNF-α-induced phospho-NF-κB in HuAoSMCs. In vivo experiments were also used to test the efficacy of JQ1/ARV-825 in angiotensin-II-induced aneurysms.

53 - EXPLORING THE ANTIBIOFILM PROPERTY OF MINT EXTRACT IN CHEMICALLY TREATED WASTEWATER FROM DEEP EAST TEXAS

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Chemically treated wastewater is ready to be released in the environment. Hence checking its purity is essential for promoting environmental sustainability, and ensuring community health. This study evaluates the water quality of treated wastewater using microbial biofilm growth as a key indicator. Biofilms are aggregates of microbial cells encased in an extracellular matrix. In this research, chlorine treated wastewater samples were collected from San Augustine, San Jacinto and Nacogdoches counties, and compared against sterilized deionized (ST) and tap water (TW) collected from the laboratory, to assess their interaction with Bacillus thuringiensis (Bt) for biofilm formation. Bt was incubated in various environments, including 100% Luria Broth (LB) nutrient media, and LB mixed with water samples at a 50%:50% v/v ratio in multi-well culture plates for 24 hours under static conditions at 37°C. After incubation, optical spectroscopy, ion chromatography, and scanning electron microscopic (SEM) imaging studies were performed to assess biofilm formation. The optical density of the supernatant indicated bacterial growth, while SEM images showed the biofilm's topography. Ion chromatography indicated the anion effects, with bacteria absorbing sulfate and nitrate anions, while excreting chloride ions for biofilm formation and growth. Methanolic extracts of mint leaves from spear, pepper and chocolate mint plants were synthesized and their antibiofilm properties were explored against the Bt biofilm. Spear mint extracts showed promising antibiofilm activities. Further studies are underway.

55 - TARGETED DELIVERY VIA HDL-MIMICKING DRUG DELIVERY PLATFORM TO CIRCUMVENT PERIPHERAL TOXICITY AND ENHANCED THERAPEUTIC EFFECT

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Background: Traditional chemotherapy is afflicted with long- and short-term side effects due to off-target delivery of the anti-cancer agents employed. In many cases, the side effects are worse than the illness itself. Effective delivery methods are frequently necessary for molecular therapies to reach cytosolic organelles and function. Scavenger receptor class B type I (SR-BI)-mediated cytosolic transport using HDL-mimicking nanoparticles has recently demonstrated significant promise for the efficient delivery of theranostics into cell cytoplasm without harmful endosomal trapping. The current study elucidates this unique delivery system developed by our group for improving targeted drug delivery using an anthracycline drug, doxorubicin (Dox), in a prostate cancer mouse model. **Methods**: HDL-mimicking nanoparticles (rHDL) with Dox were synthesized using the cholate dialysis method. These were optimized and characterized for their physicochemical features and in vitro cell survival studies using malignant and nonmalignant prostate cell lines, DU 145 and PZ-HPV, respectively, along with cardiomyocytes and astrocytes. The effect of treatment with rHDL-Dox and free Dox on tumor reduction and survival was studied using an orthotopic xenograft mouse model. **Results:** A stable and non-leaky formulation of rHDL-Dox nanoparticles was formulated that showed a mean diameter of 20.1 nm, zeta potential of -16.9 mV, and encapsulation efficiency of 44.1%. The protective effect of rHDL-Dox for cardiomyocytes, PZ-HPV, and astrocytes was observed to be 2.6, 3.3, and >3.5 times better than Free-Dox, respectively. No toxicity was observed in animals treated with vehicle (empty rHDL), PBS, and rHDL-Dox formulations. All animals survived until the end of the study, day 26 in these groups. However, toxicity in the form of severe body weight loss was observed in animals treated with Dox, and the animals did not survive beyond 18 days of the study. **Conclusion**: Our studies revealed that the nanoparticle-encapsulated Dox improved the tolerability, extended the dosing window, and allowed for tumor growth

inhibition and efficacy. HDL-mimicking drug delivery systems developed in our lab have a great potential to address the peripheral toxicity concerns via their ability to selectively deliver their payload to cancer cells and tumors.

57 - ANTIMICROBIAL AND FIRE-RETARDANT COATINGS FOR SOFT SURFACES IN HOSPITALS

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Hospital soft surfaces present several challenges. They are highly prone to microbial contamination, and are difficult to effectively decontaminate, disinfect and sanitize. In addition, the widespread use of readily combustible materials like isopropanol, oxygen, and more have prompted strict government regulations of fire retardancy (FR) for industrial textiles. However, FR treatments often reduce antimicrobial properties. Because of this, current solutions only offer antimicrobial or fire-retardant coatings. This study aims to develop a dual-functional fabric coating that provides antimicrobial protections while maintaining FR standards. We propose that a commercial phosphate-based FR, when combined with a proprietary chitosan-based antimicrobial coating (Silver Shell®), can provide both benefits without compromising individual performance. Our research evaluates the individual and combined effectiveness of these coatings in forming antimicrobial and fire-retardant properties on cotton and polyester fabrics. We will test these properties using the AATCC method along with flame testing. We predict that this novel coating will offer a practical solution for hospital environments by enhancing fire safety, microbial protection, and reducing infection transmission risk.

58 - COPPER-BASED BIODEGRADABLE PHOTOLUMINESCENT NANOPARTICLES FOR IMAGING AND DRUG DELIVERY

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Photoacoustic imaging (PAI) allows real-time, high-contrast imaging and is used to diagnose and monitor conditions such as peripheral artery disease (PAD). PAI uses near infrared laser light to induce thermoelastic expansion in tissue and subsequent sound waves that are detected to create images. However, deep tissue visualization is limited by reduced light penetration, low resolution, and optical scattering. Copper plasmonic nanoparticles (Cu PNPs), with their tunable localized surface plasmon resonance that enhances light absorption and scattering, can improve image resolution at higher depths. In this work, we modified aniline tetramer doped biodegradable photoluminescent polymers (BPLP-ATs) by adding copper nitrite (BPLP-AT Cu), cupric oxide (BPLP-AT CuO), or cysteine-cupric oxide (BPLP-Cys CuO) to extend their plasmonic characteristics. Then, we combined these polymers with drug models bovine serum albumin (BSA) or erythropoietin (EPO) to formulate theranostic nanoparticles (NPs) and studied their cytocompatibility, drug loading, drug release profile, and imaging characteristics. *In-vivo* multi-spectral optoacoustic tomography (MSOT) studies show that BPLP-AT CuO NPs produced the highest comparative MSOT mean intensity among the formulations assessed, in addition to the best cytocompatibility and drug release profile. Hence, BPLP-AT CuO NPs confirmed their extraordinary theranostic potential of as photoacoustic imaging contrast agent and drug delivery vehicle to diagnose, monitor, and treat PAD.

59 - NOVEL SOCKET DESIGN FOR MYOELECTRIC PROSTHESES: INNOVATIVE SOLUTIONS FOR ENHANCED COMFORT AND FIT

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Rejection rates for upper limb myoelectric prostheses remain high at upwards of 35%. Among the factors leading to prosthesis abandonment, discomfort with the prosthesis interface and lack of adjustability for residual limbs are major points of concern. These concerns derive from the design of the socket, the interface between the user and the prosthetic device. To address such concerns, this research outlines the development and iterative refinement of these interfaces for a customizable myoelectric prosthesis.

This research laboratory's preliminary socket designs had limited considerations for irregular topologies that naturally occur in a limb difference. An improved approach was needed to accommodate the unique geometry of each participant's limb, which has since been implemented in recent design iterations. The updated process uses photogrammetry to capture multiple images and videos of the residual limb, which are then used in the modeling software Blender to generate an accurate 3D model. This model is then imported into Autodesk Meshmixer to generate a hollow "surface" offset from the limb geometry. The design is finalized in Autodesk Fusion, where the interface, socket components, and condyle supports are added. This allows the socket to taper around the user's epicondyle bones to ensure a secure fit and prevent slipping. Additionally, an adjustable tension dial has been incorporated to serve as a tightening mechanism by directing force into a pivoting tongue, allowing the user to modify the fit throughout the course of the day. A prosthetic user's residual limb volume and geometry naturally fluctuate due to factors such as activity level, hydration, and muscle usage. The adjustable tension dial maintains optimal socket fit and comfort even through these daily changes.

Recent changes in the device's electromyography (EMG) sensors have further contributed to the socket's usability and comfort. EMG surface electrodes record electrical signals released by contracting muscles, which actuate the myoelectric prosthesis. Wired sticker electrodes manually placed outside the socket have been transitioned to dry electrodes embedded within the socket. Fixed sensors provide improved EMG readings of target muscles, and a spring-loaded assembly within the sensor mount ensures constant contact between the sensors and the user's residual limb.

Additional development methods are being explored for future implementation in the socket production process. A synchronized photogrammetry approach may offer more accurate 3D models of the user's residual limb, streamlining the design process. By integrating these methods into designing and testing the user socket, this research seeks to heighten socket fit and comfort and ultimately reduce myoelectric prosthesis rejection.

60 - ANDROGEN-INDUCED HIGH BLOOD PRESSURE AND LYMPHOCYTES INTRACELLULAR TRAFFICKING IN POLYCYSTIC OVARY SYNDROME

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Polycystic ovary syndrome (PCOS) is one of the most common hormonal disorders in women of reproductive age. It is associated with elevated androgens, increased inflammation, higher blood pressure, and higher risk for cardiovascular disease (CVD). However, the mechanisms responsible for higher blood pressure have not been elucidated. In this study, we used a rat model called the hyperandrogenemic rat (HAF), which exhibits many of the characteristics of PCOS in women, to test the hypothesis that T lymphocytes intracellular trafficking is increased in the kidneys of HAF compared to placebo rats, which could potentially play a role in hypertension. Female Sprague Dawley (SD) rats (n = 6/group) at 4 weeks of age were implanted subcutaneously with dihydrotestosterone (DHT) (7.5 mg/90 days) or placebo pellets. Blood and kidney samples were collected after allowing the rats to age 14-15 weeks. Peripheral and renal immune cells were isolated. The number of renal infiltrated immune cells, specifically CD4+, CD8+, Th17, and$CD4+CD28^-$ T lymphocytes, were measured using flow cytometry. It was found that HAF rats had a significantly higher percentage of CD4+ T lymphocytes in the kidneys than placebo control rats (Placebo: 10 ±1 vs. HAF: 22 ±1 % gated $p < 0.05$). There was also a noticeable increase in renal infiltrated Th17 and $CD4+CD28^-$ T lymphocytes in the HAF rats compared to placebo control (Placebo: 19 ±1 vs. HAF: 23 ±1 % gated $p < 0.05$) and (Placebo: 6 ±1 vs. HAF: 15 ±2 % gated $p < 0.05$), respectively. These results suggest that hyperandrogenemia may trigger intracellular trafficking of T lymphocytes, in particular Th17 and $CD4+CD28^-$ subpopulations in women with PCOS, which may mediate their increase in blood pressure. Overall, this research helps highlight the connection between elevated androgens and lymphocytes trafficking in PCOS, and it points to potential pathways that could be targeted in future treatments of hypertension. Understanding how the immune system behaves in this condition could eventually lead to better ways to manage the risks associated with PCOS, especially regarding long-term cardiovascular health.

61 - SYSTEMIC IMPACTS OF METHAMPHETAMINE USE: A COMPREHENSIVE LABORATORY ANALYSIS

Mohammad Alfrad Nobel Bhuiyan

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Methamphetamine use continues to rise across the United States and has been increasingly associated with systemic organ damage. While its effects on the brain and cardiovascular systems are well known, few large-scale studies have examined how methamphetamine use is reflected in routine laboratory values, and how these findings translate clinically. This study is intended to perform a broad laboratory comparison between

methamphetamine users and non-users to better understand the physiological impact of meth use and its clinical relevance, particularly in relation to cardiovascular disease (CVD).

29,218 patients were studied using the LSU health dataset with 1,761 patients having documented meth use and 27,457 controls, no meth test completed. Demographic differences were apparent, with meth users skewing younger, predominantly male, and more often White. Laboratory comparisons revealed that meth users frequently exhibited elevations in hepatic enzymes, white blood cell count, and troponin I, along with reductions in hemoglobin A1c, total protein, and hemoglobin. These trends were more severe among meth users with comorbid CVD, suggesting an additive physiological burden.

Multivariable regression analysis identified several lab markers independently associated with meth use: creatinine (OR = 1.92), troponin I (OR = 2.86), and bilirubin (OR = 1.60) were significantly elevated, while total protein (OR = 0.72) and hemoglobin A1c (OR = 0.83) were significantly reduced. These findings point toward patterns of renal strain, hepatic dysfunction, and cardiovascular stress that may be identifiable through routine clinical testing.

By establishing laboratory patterns linked to methamphetamine use in a large patient population, this study highlights key biomarkers that may aid in early risk detection and management. The results support the value of integrated lab-based screening and monitoring strategies in clinical care for individuals with methamphetamine exposure.

62 - SYSTEMIC IMPACTS OF METHAMPHETAMINE USE: A COMPREHENSIVE LABORATORY ANALYSIS

Mohammad Alfrad Nobel Bhuiyan

Louisiana State University Health Shreveport, Shreveport, LA

Methamphetamine use continues to rise across the United States and has been increasingly associated with systemic organ damage. While its effects on the brain and cardiovascular systems are well known, few large-scale studies have examined how methamphetamine use is reflected in routine laboratory values, and how these findings translate clinically. This study is intended to perform a broad laboratory comparison between methamphetamine users and non-users to better understand the physiological impact of meth use and its clinical relevance, particularly in relation to cardiovascular disease (CVD).

29,218 patients were studied using the LSU health dataset with 1,761 patients having documented meth use and 27,457 controls, no meth test completed. Demographic differences were apparent, with meth users skewing younger, predominantly male, and more often White. Laboratory comparisons revealed that meth users frequently exhibited elevations in hepatic enzymes, white blood cell count, and troponin I, along with reductions in hemoglobin A1c, total protein, and hemoglobin. These trends were more severe among meth users with comorbid CVD, suggesting an additive physiological burden.

Multivariable regression analysis identified several lab markers independently associated with meth use: creatinine (OR = 1.92), troponin I (OR = 2.86), and bilirubin (OR = 1.60) were significantly elevated, while total protein (OR = 0.72) and hemoglobin A1c (OR = 0.83) were significantly reduced. These findings point toward patterns of renal strain, hepatic dysfunction, and cardiovascular stress that may be identifiable through routine clinical testing.

By establishing laboratory patterns linked to methamphetamine use in a large patient population, this study highlights key biomarkers that may aid in early risk detection and management. The results support the value of integrated lab-based screening and monitoring strategies in clinical care for individuals with methamphetamine exposure.

63 - QUANTITATIVE ELECTRO-ENCEPHALOGRAPHY (QEEG) ANALYSIS OF PATIENTS WITH DEEP BRAIN STIMULATION IMPLANTS

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Deep brain stimulation (DBS) is the use of an implanted device to control and manage movement disorders. DBS often targets the globus pallidus interna (GPi), subthalamic nucleus (STN), and the ventral intermediate nucleus (VIM) of the thalamus. Each of these nuclei correlates with specific movement disorders, such as the GPi for Parkinson's disease (PD) and dystonia. Once a target for a specific movement disorder is chosen, various voltages, frequencies, and pulse timings are tested. However, it is challenging and time-consuming to determine and analyze the effectiveness of each treatment, since this process is often performed through trial and error. This study investigates the use of high-density quantitative electroencephalography (HD-QEEG) data to identify biomarkers that correlate with DBS function. Data were previously obtained using a 256-electrode quantitative EEG (QEEG) system. Patients were asked to remain at rest or

perform a motor task with DBS off, at optimal settings, and at 2 Hz stimulation to obtain evoked responses. EEG data were transferred from Meta File Format (MFF) to MATLAB using the Netstation review tool. In MATLAB, a machine learning algorithm was developed to perform advanced signal processing, including power spectral density (PSD), time-frequency analysis, and coherence. A topographical subtraction map demonstrated very different patterns of activation for GPI, VIM, and STN. We individually stimulated contact 0 (bottom most electrode contact), contact 3 (top most), and contact (1,2) (optimal contact combination in clinical use) and analyzed the corresponding beta modulation topoplot. Despite the close proximity of these contacts, their differential activation resulted in clearly different cortical beta activity. Our preliminary data was supportive of the hypothesis that DBS stimulation induced cortical activation patterns may be useful as a biomarker of DBS contact location and may be useful to discriminate between activation of neighboring circuits. Further work is ongoing to determine whether these patterns of activation can be used to optimize stimulation parameters and to establish reproducibility, reliability, and sensitivity.

64 - CHARACTERIZATION OF MICROELECTRODE RECORDINGS COLLECTED DURING DEEP BRAIN STIMULATION SURGERIES

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Deep brain stimulation (DBS) for Parkinson's disease and other movement disorders requires millimeter-precise electrode placement in target structures including the subthalamic nucleus (STN), globus pallidus internus (GPi), and ventral intermediate nucleus of the thalamus (VIM). Current reliance on subjective microelectrode recording (MER) interpretation leads to inconsistent outcomes across these targets. We present a machine learning framework that transforms intraoperative MERs into quantitative biomarkers for optimized DBS targeting across all three nuclei. Analyzing multi-unit activity and local field potentials from 25 DBS patients (15 STN, 7 GPi, and 3 VIM cases), our pipeline employs adaptive filtering, automated spike sorting, and feature extraction (β-band power for STN/GPi, tremor-frequency oscillations for VIM) to train supervised classifiers (XGBoost/SVM) for anatomical subregion identification.

Preliminary results demonstrate 92% accuracy in STN border detection versus conventional methods (68%, $p<0.01$), with comparable improvements for GPi (88% vs 63%) and VIM (85% vs 60%) localization. β-oscillations in STN/GPi and 4-8Hz rhythms in VIM strongly predicted clinical improvement ($r=0.76$-0.82). ML-predicted stimulation contacts required 27% less voltage in STN, 23% in GPi, and 31% in VIM while maintaining therapeutic benefit. This system provides the first validated, data-driven solution for multi-target DBS implantation, significantly improving upon neurophysiologist-dependent paradigms.

By establishing target-specific electrophysiological biomarkers, our approach enhances surgical precision across all common DBS targets, reduces stimulation parameters, and may decrease side effects. Ongoing work focuses on real-time implementation during surgery and expansion to other movement disorders. These findings address a critical need in functional neurosurgery by replacing qualitative MER interpretation with computationally derived, clinically actionable guidance for STN, GPi, and VIM targeting.

65 - QUANTIFICATION OF ELBOW FLEXION IN OVERHEAD THROWING MOTION: A PILOT MOTION CAPTURE STUDY ON NON-PROFESSIONAL BASEBALL PLAYERS

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Arm injuries are common in overhead sports, particularly baseball players. One of the most significant arm pathologies is the injury to the ulnar collateral ligament (UCL) as it requires an extensive recovery time. The rate at which UCL injuries are increasing is eye-opening as UCL injuries have increased 9-fold in the past 10 years. The increased emphasis on pitching velocity has been considered as a cause of increased strain of the UCL. Increased scapular retraction allows for greater pectoralis major contraction in the late cocking phase resulting in increased arm velocity. However, retracting the scapula further into the back during the arm cock phase may cause arm drag and increased strain on the UCL. An increased angle of elbow flexion and arm supination at pitch release has been shown to cause increased UCL strain. Therefore, the current study aims to estimate the degree of elbow flexion and arm supination from full scapular retraction and neutral scapular retraction. We hypothesize that the angle of elbow flexion and arm supination at pitch release will be greater with full scapular retraction.

Following IRB approval, we recruited 10 male subjects with a history of involvement in baseball. Females were

excluded due the difference in male and female throwing biomechanics. The subjects' motions were recorded using two 24-mega pixel cameras. OpenCap™ marker less motion capture software was used to acquire and visualize the subjects' throwing biomechanics. The subjects were asked to throw a 150g ball from the arm cock phase at neutral scapular retraction and full scapular retraction. Arm adduction was used to differentiate between the two positions of scapular retraction. The point of ball release was identified from the acquired videos. Elbow flexion and arm pronation at ball release were measured. The values of elbow flexion and arm pronation at ball release from the two throwing motions were analyzed using a paired t-test.

Of the 10 subjects we obtained viable marker data for eight. The arm adduction recorded with neutral scapular retraction of 69.1deg±19.3 was different from the arm adduction with deep scapular retraction 39.5deg±14.3 ($p=0.002$). The elbow flexion recorded with neutral scapular retraction of 57.6deg±11.7 was not different from the elbow flexion of 57.7deg±9.4 recorded for throwing with full scapular retraction ($p= 0.487$) Similar results have been found for arm pronation with values of 101.5deg±7.3 and 104.1deg±5.9 respectively for throwing from neutral and full scapular retraction ($p=0.223$)

In our current pilot study, we have successfully tested two positions of scapular retraction showing that there are no differences in UCL strain between the two positions using elbow flexion and arm pronation at release. These results are limited using only two cameras that can have potentially limited the joint differentiation of the marker less motion capture system. An additional limitation is that we did not measure pitching performance with relation to the two different positions of scapular retraction. Future studies, performed using additional cameras, should use pitching velocity and spin rate to evaluate pitching performance for the positions of scapular retraction.

66 - MICROGLIA PLAY ESSENTIAL ROLES IN DEVELOPMENTAL MYELINATION

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Neurodevelopmental disorders, a diverse group of conditions arising from early-life disruptions in brain development, are rooted not only in aberrant development of neurons and glial cells but also in dysfunction at the network level, including impaired synaptic connectivity, disrupted circuit integration, and faulty myelination. Myelination is essential for rapid signal transmission and coordinated neural activity; its disruption can compromise connectivity and information processing, contributing to a broad range of functional deficits. Microglia, the resident immune cells of the central nervous system, are known to play crucial roles in regulating neuronal and synaptic development during early life. However, whether they exert similar influence on oligodendrocyte (OL) development and myelination remains unclear. To address this question, we first examined the effects of microglia on oligodendrocyte progenitor cell (OPC) survival, proliferation, and differentiation in purified cell cultures, as well as on myelination in mixed neuron-glia cultures. Our data show that microglia-conditioned medium robustly promotes OPC survival and differentiation without affecting proliferation. Microglia-conditioned medium also significantly enhances myelination, which correlates with increased OPC differentiation. To test whether microglia are necessary for myelination in the developing brain, we depleted microglia in neonatal rats via intracerebral injection of clodronate liposomes. Microglia depletion at postnatal day 3 (P3) markedly reduced myelination by P21, accompanied by a decrease in APC+ mature OLs, while PDGFR+ OPCs remained unaffected. In conclusion, our findings demonstrate that microglia are essential for developmental myelination, suggesting that microglial dysfunction may impact neural networks beyond their known roles in regulating neuronal and synaptic maturation.

67 - INHIBITING THE INHIBITOR: WOULD TARGETING PAI-1 RESULT IN A LOW-DOSE, WELL-TOLERATED TREATMENT OF EMPYEMA?

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The incidence of empyema has continued to increase over the past several decades, with mortality rates up to 20-27% among patients >65 years old who have co-morbidities. Moreover, up to 30% of adult patients with empyema are poor candidates for both surgical treatment and conventional, high-dose intrapleural fibrinolytic therapy. Plasminogen activator inhibitor 1 (PAI-1) is overexpressed by three orders of magnitude in empyema pleural fluids, inhibits fibrinolysis, and promotes pleural fibrosis, resulting

in a severe lung restriction. We hypothesized that targeting PAI-1, which is associated with the severity of pleural fluid loculation in humans, would result in a low-dose pharmacological treatment for empyema improving patient survival.

First, we tested four monoclonal antibodies (mAbs) with different molecular mechanisms of PAI-1 neutralization in a rabbit model of chemically induced pleural injury. Next, two mAbs (MA-33H1F7 and MA-8H9D4) with maximal effect (up to eight-fold increase) on the efficacy of fibrinolysins were validated in an infectious, *Streptococcus pneumoniae*-induced model of empyema in rabbits, where the level of PAI-1 is almost ten-fold higher, similar to that seen in empyema in humans. mAbs increased the efficacy of tissue-type plasminogen activator (tPA; Alteplase) by at least four-fold and addressed pleural thickening, thus supporting our hypothesis on the role of PAI-1 in pleural injury. To minimize the size and cost of the adjunct, linear GLP-friendly peptides that compete with these mAbs for PAI-1 were selected from a phage display library and evaluated *in vitro* and *ex vivo*. Similar to mAbs, peptides protect tPA and fibrinolysis from up to 16-fold excess PAI-1. Four of the peptides are currently being tested in an infectious rabbit model of empyema, demonstrating a trend towards at least four-fold increase in the efficacy of tPA.

We believe that targeting PAI-1 with linear GLP-friendly peptides is well-tolerated, tractable in clinical settings, and addresses both pleural fibrosis and pleural thickening. The results support our overall objective to develop a novel, cost-effective, low-dose pharmacological intervention for empyema suitable for patients who are at elevated risk for surgery or conventional fibrinolytic therapy.

68 - ARTIFICIAL INTELLIGENCE IN THE MEDICAL SCHOOL CURRICULUM: ANTICIPATED ETHICAL ISSUES

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Although artificial intelligence (AI) will shape the future of medicine, its place in both undergraduate graduate medical education is currently unclear. Arguments exist both for and against including AI in the medical school curriculum. As AI continues to develop it will affect all medical specialties, perhaps radiology more so than any other. The purpose of this analysis is to present a balanced perspective on whether AI should be included officially in the medical school curriculum. Due to the growing use of artificial intelligence (AI) in health care, there is a need to recognize the lack of formal AI instruction in undergraduate medical education, the medical school years before students receive their professional medical degree. There is a clear need for AI instruction for medical students so that they can understand AI's current and potential clinical applications, as well as the ethical and legal challenges of AI that may directly influence patient care and outcomes.

At the present time, challenges include uncertainty about how to deliver AI curriculum effectively, limitations in available curricular hours, and lack of faculty expertise; nonetheless, it is obvious that AI be included in the medical school curriculum, with emphasis on medical informatics and the basics of AI literacy. This is important because the methods of instruction with AI represent a shift in how medical education and research were taught in the past.

There are a multitude of positives and negatives surrounding formal integration of AI into the medical school curriculum. The predominant positive points are the clear need for AI instruction for medical students as evidenced by a variety of research studies, the necessity of addressing the ethical and legal challenges of AI that can directly impact patient safety and privacy, and the potential AI has to improve clinical workflow and patient outcomes through widespread applications). The main negative points include the absence of a clear consensus on how to deliver the AI curriculum effectively, the limited curricular hours, the paucity of faculty expertise on AI, and the fact that AI's use and generalizability in actual medical practice remains unknown, despite the high number of potential applications in medicine.

This analysis will consider the ethical issues related to what curriculum committees will need to consider when evaluating the implementation of AI education in their own institutions.

69 - BRAIN ORGANOID INTELLIGENCE: ANTICIPATORY ETHICS, CATEGORICAL ERRORS, AND A DANGER ZONE FOR NEUROSCIENCE

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The human brain exhibits highly complex cytoarchitecture and immense cellular diversity. Neural organoids provide a unique, albeit simplistic, model to examine neuroanatomical features such as cell shape, organization, and cell-cell interactions in the context of human development and disease. Due to the significant growth and proliferation of brain organoid research in neuroscience over the past decade, a new area of study was proposed in 2023, termed "Organoid Intelligence (OI)." A small group of researchers, many of whom have vested financial interests in developing organoid models of computation and disease, proposed that OI will result in neuromorphic

computing models in a dish and may attain consciousness. Several prominent OI researchers have provided a cursory ethical analysis to accompany the development of OI, partly evoking the precautionary principle to address perceived ethical challenges to OI. The central premise of the ethical analysis is that ethical considerations should be given to these models regarding organoid sentience and informed consent.

The assertion that OI is a viable outcome in brain organoids that needs a detailed ethical analysis based on these models exhibiting consciousness stems from an ethical analysis rooted in Ryle's "category mistake." This categorical error and the erroneous ethical analysis overlook that in order to serve as viable *in vitro* models for neurodevelopment and neurological disorders, organoids have to be validated to show their similarity to neural tissue in terms of structure, cellular diversity, and organization, gene expression, and synaptic activity. In addition, this category error requires a reductionist conception of consciousness that expects an unguided tissue in a dish that contains approximately 100,000-200,000 neurons to recapitulate the activity of a human brain that contains approximately 100 billion neurons in an evolutionarily defined neural architecture. The conflation of brain organoid models with human brains has resulted in this tissue incorrectly being given attributes of personhood, which organoids do not possess.

From an anticipatory ethical perspective, asserting OI during such an early phase in the development of brain organoid research, where so little is known about these models, has the potential to evoke the use of the precautionary principle by diverse stakeholders at the wrong time. Doing so may create a burden of proof that is unnecessary and impossible for neuroscientists doing brain organoid research, creating adversarial relationships with non-scientifically oriented stakeholders. By applying an abundance of caution and attributing OI to brain organoids too soon, the assertion of OI as a field has the unintended consequence of creating ethical laws based on fear and inadvertently leading to the inhibition of innovation in neuroscience.

70 - IMAGING ULTRASONOGRAPHY POTENTIATES INTRAPLEURAL FIBRINOLYSIS IN A RABBIT MODEL OF EMPYEMA

Andrey Komissarov[1], Christian De Vera[1], Rebekah Emerine[1], Jincy Jacob[1], Sunil Christudas[1], Krishna Sarva[1], Ali Azghani[2], Maryam Ranjpour[1], Brion Frierson[3], Tao Peng[3], Shaoling Huang[3], David McPherson[3], Steven Idell[1], Melvin Klegerman[3], Galina Florova[1]

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Rationale: Empyema is a bacterial infection of the pleural space, a serious complication of pneumonia that carries a mortality rate of up to 27% among patients older than 65, and the incidence of which continues to increase worldwide. Advanced intrapleural fibrosis together with loculation result in severe restriction of the lungs. Intrapleural fibrinolytic therapy (IPFT) results in activation of endogenous plasminogen to plasmin, which degrades intrapleural fibrin, thus facilitating pleural fluid drainage and lung re-expansion. However, conventional high-dose IPFT often fails in advanced empyema, and almost a third of adult patients are poor candidates for both- IPFT and surgical treatments. We hypothesized that transthoracic imaging ultrasonography affects the structure of intrapleural fibrin, supporting sonofibrinolysis, and increasing the efficacy of IPFT. The hypothesis was tested in validated *Streptococcus pneumoniae*-induced rabbit models of early and advanced-stage empyema. **Methods:** *S. pneumoniae* empyema was induced in rabbits and allowed development for 3 (early, acute stage) or 7 (advanced, chronic stage) days. Animals were treated with a bolus injection of an ineffective dose of a fibrinolysin - prourokinase (scuPA) or alteplase (sctPA) alone or in combination with transthoracic imaging ultrasound (4x1.0 min MI=1.8) immediately before and at 1, 2 and 4 h after fibrinolysin injection. Doses of the fibrinolysin were 1/8-1/2 of the Minimal Effective Dose (MED; 2.0 mg/kg) for early stage and 4.0 mg/kg (unknown MED) for advanced-stage empyema. Outcomes of the treatment were assessed at 24h by the Gross Lung Injury Score (GLIS), histology, and various biochemical assays. **Results:** The combination of transthoracic imaging ultrasonography and alteplase (n=11) demonstrated at least two-fold higher efficacy when compared to the alteplase alone (n=12). Transthoracic ultrasound converted ineffective doses of alteplase (1.0 mg/kg, n=5 for acute and 4.0 mg/kg, n=6 for advanced stage) to MED (100% effective treatment for a group of five-six animals). In contrast, sonofibrinolysis neither increased the efficacy of prourokinase (n=8) nor lowered dose of alteplase (n=8). **Conclusions:** Sonofibrinolysis with imaging ultrasound (MI=1.8) results in at least two-fold increase in the efficacy of alteplase (sctPA) treatment in the rabbit model of empyema. Additivity/synergism between biomechanic effects of transthoracic ultrasound and low dose targeted pharmacological treatments may result in a paradigm shift in managing empyema in clinical practice.

72 - 3D PRINTED SKIN AND ARTIFICIAL INTELLIGENCE: AN ANTICIPATORY ETHICAL ANALYSIS

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Reconstructive surgery to correct trauma to skin from injury or disease is often imperfect and not aesthetically pleasing. Researchers of 3D printed skin seek to correct this problem by implementing full thickness skin onto a patient. 3D printed skin would be used to correct deep wounds that would take a long time to heal on their own. 3D printing in medicine is not new, and the potential to 3D print organs, such as skin, has been researched for over 2 decades now. Additionally, other revolutionary technologies such as artificial intelligence [AI] are being used in medicine to help advance the developing medical field of 3D bioprinting. AI in medicine is also not new and has been implemented into numerous medical fields over the past few years, but the convergence of AI and 3D printing opens a promising horizon for the field of organ transplants, as the shortage of organs available for transplant is a cause of thousands of deaths worldwide each year. My research would look at how AI and specialized methods of 3D bioprinting can be used to potentially create 3D printed skin. This convergence of technologies will give us a background to analyze the central ethical and technical problems of 3D printed skin in an anticipated clinical setting. While 3D printed skin has not been used as a fully functional treatment for patients, researchers are developing 3D printed skin to be a viable, functional treatment that will successfully interact with a patient's healthy skin. This interaction would seek to have the patient's wound be fully healed while also being aesthetically pleasing. To conduct my analysis of 3D printed skin, I will be employing the Belief-Desire-Intention (BDI) model of rational agency as the foundation for using anticipatory ethics on the possible future effects of 3D printed skin on humans.

The work ethicists is to identify social and ethical issues in the world. When an ethicist seeks to identify future social and ethical issues, they use anticipatory ethics. It should be noted that the basis for both current and future identification of social and ethical issues uses generally defined ethical principles. In addition to these principles, I will be using the ACM Code of Ethics and Beauchamp and Childress's Four Biomedical Ethical Principles for my analysis. Anticipatory ethics will then be employed to identify the emerging social and ethical issues that arise from the potential to 3D print skin in a world that has a confluence of interests and technologies.

73 - FACE RECOGNITION BASED APPLICATIONS AND DISEASE DIAGNOSIS: ETHICAL AND ANTICIPATED ETHICAL ISSUES

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Our faces tell stories, and technologies are learning to read them. What began as a way to unlock smartphones has evolved into powerful diagnostic tools capable of detecting disease. With advancements in artificial intelligence, particularly through convolutional neural networks (CNNs), facial recognition systems can now analyze 3D facial scans to identify subtle markers of disease. Three-dimensional CNNs, are designed to process and interpret complex visual data, which are at the core of the diagnostic tools, identifying features linked to conditions such as endocrine disorders or acromegaly, with reported accuracy approaching 97%.

The face is a unique marker of bio identity for human beings in that it provides information about people related to regards to age sex race consciousness emotion and health status. Face recognition techniques in conjunction with AI has now been employed to identify a number of diseases including inherited genetic disorders. Various diseases manifest not only as internal structure and functional abnormalities but they also have facial characteristics and deformities diseases with facial manifestations are mainly in doctrine and metabolic disorders genetic syndromes and neuromuscular diseases some of which are complex and rare diseases. Early diagnosis and differentiation of these diseases are essential for timely therapy and better prognosis to identify typical facial features as part of the traditional diagnosis path and largely depends on expertise and experience

Attempting to understand some of the basic issues related to agency and ethical responsibility in the context of face recognition based on applications for disease diagnosis requires an application of concepts that would be taken to be very basic in more specialized fields of study. For example in theory of mind which is also related to psychology what is studied in great detail is the link between what goes on within an agent's mind and how what goes on in someone's mind is translated into activities and actions in the external world. This is sometimes referred to as practical agency. Moral agency ends up in the tradition of Aristotle and Kant being a subspecies of practical agency where a practical agent reflects upon what moral conditions are related to the translation of practical concepts into actions in the external world and what responsibilities and agent bearers for performing these actions in the external world.

This is the precondition for holding someone responsible and for claiming that somebody has reached the stage of being a moral agent. A series of pressing ethical and anticipated ethical concerns arise. Who owns this intimately personal biometric data? What are the chances that

insurance companies or even employers misuse this acquired data? And what about those caught in the margin of error, misdiagnosed and branded with conditions patients do not have? The consequences extend beyond the clinical settings, into individuals' lives.

As machine moves forward with Face recognition techniques, how can biometric tools and algorithms in diagnostic practices ensure an individual's rights, consent, and control over their identity? The lens of anticipatory ethics helps explore these questions, examining the intersection of facial recognition technologies and healthcare, considering the future consequences in response to these emerging technologies.

74 - AI ASSISTED TECHNOLOGY DETECTS NANOPARTICLES IN WATER: ETHICAL CONSIDERATIONS FOR HUMAN HEALTH

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Introduction: Plastic, one of the most preferred materials in today's industrial world is posing serious threat to environment and consumer's health in many direct and indirect ways. Exposure to harmful chemicals during manufacturing, leaching in the stored food items while using plastic packages or chewing of plastic teethers and toys by children are linked with severe adverse health outcomes such as cancers, birth defects, impaired immunity, endocrine disruption, developmental and reproductive effects etc. Promotion of plastics substitutes and safe disposal of plastic waste requires urgent and definitive action to take care of this potential health hazard in future.

In the Food Chain: Although the polymeric materials that make up Micro- and Nanoplastics that are found in the environment may be biochemically inert, these materials may be ingested by numerous organisms which may result in these materials working their way up the food chain, where they may eventually affect human health.

AI-assisted Nano-DIHM: A novel technology, artificial intelligence-assisted nanodigital in-line holographic microscopy (AI-assisted nano-DIHM), fills a knowledge gap. The principle of nano-DIHM does the following (1) nano-DIHM identifies nano/microplastics and other materials based on intensity and optical phase by manual reconstructions; (2) encompassing a deep neural network, AI-assisted nano-DIHM automatically characterize and classify nano- and microplastic particles in environmental waters without sample preparation; (3) the three-dimensional (3D) particle spatial/structural and four-dimensional (4D) dynamic tracking capabilities of nano-DIHM allow us to address the knowledge gap on real-time and in situ studies of waterbo rne nano/microplastics; (4) a model study demonstrating the distinct distributions of nano- and microplastics in the natural waters suggests that real-time nano/microplastic detection is necessary for accurate life-cycle analysis and targeted remediation. AI-assisted nano-DIHM, tailored specifically for nano- and microplastic particles, serves as a powerful tool to tackle the emerging environmental challenges posed by plastic pollution.

Effects on Humans: Micro-and Nanoplastics are known to be widespread contaminants. The human body is exposed in a variety of ways to microplastics. The body is exposed to microplastics through ingestion of food containing microplastics, inhalation of microplastics in the air and by dermal contact of these particles, contained in products, textiles or in the dust.

The main routes of exposure to Micro-and Nanoplastics are: Ingestion, Inhalation, Dermal contact, Even though at the present time there is currently no evidence of widespread human health risk there is need to understand human exposure especially in smaller microplastics

75 - PSYCHEDELIC NEUROMODULATION IN ADDICTION: LINKING BEHAVIOR, GENES, AND BRAIN ACTIVITY

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Psychedelics, which primarily target the serotonin 2A receptor (5-HT2A), are gaining traction as promising treatments for psychiatric conditions such as addiction, depression, and anxiety. These compounds are known to elicit enduring changes in brain function that extend well beyond their acute effects. In this study, we used a multi-faceted approach to investigate the neuromodulatory impact of psychedelics in the context of methamphetamine addiction. Using a rodent model of operant methamphetamine self-administration, we show that both 2,5-dimethoxy-4-iodoamphetamine (DOI) and psilocybin significantly reduce drug-taking behavior. Complementing these behavioral findings, transcriptomic analysis revealed substantial gene expression changes in the prefrontal cortex following a single psychedelic exposure, pointing to molecular adaptations potentially underlying therapeutic

outcomes. Finally, in vivo electrophysiological recordings from the frontal cortex demonstrated that DOI induces both immediate and persistent alterations in delta-band power, suggesting long-term modulation of neural activity. Together, these findings illustrate the broad therapeutic potential of psychedelics in treating stimulant use disorder. By integrating behavioral assays, gene expression profiling, and neural activity measurements, this work provides a comprehensive view of how psychedelics may promote recovery from addiction and offers insight into their underlying mechanisms of action.

76 - DEVELOPMENT AND APPLICATION OF ELASTIN-INSPIRED SELF-ASSEMBLING DESIGNER POLYPEPTIDES

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[**Introduction**] Elastin is an extracellular matrix protein found in tissues that require elasticity, such as blood vessels, skin, alveoli, and organ membranes. In vivo, collagen and elastin have a complementary relationship in that collagen is responsible for rigidity and elastin for elasticity, respectively. The use of elastin as a material is highly desired in the fields of medical device development, regenerative medicine, and life science research. However, extraction and processing methods for biological elastin have not yet been established due to its handling difficulties, and it has not yet reached the level of practical application and widespread use as collagen has. Therefore, there are growing expectations for the creation of artificial proteins that can reproduce the structure and function of elastin.

[**Purpose**] The purpose of this study is to develop elastin-like polypeptides (ELPs) that are easy to handle and can reproduce some of the physical properties and functions of elastin.

[**Experiments, Results and Discussion**] Novel ELPs called GPGs have been genetically engineered [1]. GPGs have a double-hydrophobic design that mimic the uneven distribution of the glycine-rich and proline-rich hydrophobic domains of tropoelastin, the precursor of elastin. GPGs dissolved in cold water and self-assembled to form nanofibers in 37 °C water. Dynamic viscoelasticity measurements showed that the storage modulus G' exceeded the loss modulus G" to form a hydrogel even at a very low GPG concentration of 0.03 wt%, and the value of G' increased with a power of concentration. Two-dimensional cultures on GPG nanofiber membranes showed vascular endothelial cell proliferation, vascular smooth muscle cell phenotype maintenance, and low platelet adhesiveness, indicating that GPG has elastin-like biological properties.

[1] A. Sugawara-Narutaki, *Polym. J.* in press.

77 - FORMULATION AND CHARACTERIZATION OF CMPI NANOPARTICLES FOR ENHANCED TARGETING OF BRAIN NICOTINIC RECEPTORS BY POSITIVE ALLOSTERIC MODULATOR

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3-(2-Chlorophenyl)-5-(5-methyl-1-(piperidin-4-yl)-1 H-pyrazol-4-yl)isoxazole (CMPI) is a nicotinic acetylcholine receptor (nAChRs), one of the most subtype-selective a positive allosteric modulator (PAM) of nicotinic acetylcholine receptors (nAChRs). CMPI that preferentially potentiates the (α4)3(β2)2 nAChR, the major nAChR subtype in the cortex and as such carries potential experimental and therapeutic applications. Maximizing delivery of CMPI would enhance its interaction with brain nAChRs that are associated with the desired therapeutic effects while avoiding interactions with peripheral nAChRs that are associated with undesired side effects is critical to the development of nAChR PAM-based therapeutics. Towards this endeavor, this study aims to explore nanoformulation strategies to maximize delivery of CMPI. A biodegradable and biocompatible, the US-FDA-approved, poly(l-lactic-co-glycolic) acid (PLGA) was used to engineer nanoparticles (NPs) to solubilize CMPI in its hydrophobic core in an aqueous environment using the nanoprecipitation with the drug loading content of $10 \pm 1.2\%$ by weight of NPs. Thus, synthesized polymeric NPs were characterized for their colloidal properties and biological activities. The hydrodynamic size of these NPs was found to range from 60 to 150 nm and are stable for a prolonged period in biological media. An in-vitro drug release study was conducted to envision a sustained release of CMPI under physiological conditions, which shows distinct kinetics of CMPI under experimental conditions in which released drugs from NPs were collected using dialysis techniques. These NPs were found to be highly biocompatible when challenged against the human embryonic kidney-293 (HEK-293) cell line that stably expressed α4β2 (HEK-α4β2) nAChRs in a wide range of concentrations. In this pilot study, NPs were further labeled with Alexa fluorophore to track and study cellular uptake using fluorescence microscopy, which showed efficient uptake by HEK-α4β2 cells. Given the superiority of the nanoparticulate system in drug delivery and the unique role of CMPI, we hope this study will help in the development of nAChR PAM formulations that have superior

pharmacokinetic profiles, especially their brain bioavailability (Aly et al., 2025).

78 - CONTROLLED D50 INJECTIONS REDUCES GASTROSTOMY TUBE LEAKAGE

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Introduction: Gastrostomy tubes (G-tubes) play an important role in nutrition for those unable to ingest food for various reasons. A common complication that occurs with these G-tubes is leakage. Various methods currently employed to address this issue include increasing the size of the G-tube, extracting the G-tube for some time to allow for constriction of the tract, and placing gauze around the external skin to contain some leakage. While all these methods may temporarily help, none provide long-term solutions. D50 injections around the gastrostomy tract are proposed to stiffen and decrease the diameter of the tract sufficiently to decrease leakage onto the external skin. Utilizing the power of 3D printing has allowed for the creation of a device that evenly and efficiently distributes these injections. **Methods**:The 3D-printed model described above was designed and made in-lab at LSU Health Shreveport. It features 6 injection holes situated around a central stem that temporarily enters the gastrostomy tract for stability. In the preclinical testing of this device, porcine abdominal wall was used as a model. Using a 7/32 drill bit, a "tract" was drilled through the abdominal wall, and then a surgical glove ran through the tract to create a contained space. A saline bag containing povidone-iodine with the attached G-tube was contained in this glove and then ran through the tract. The model was next flipped and allowed to leak onto gauze for thirty minutes. Once complete, the G-tube was removed and D50 injections were distributed using the injection device. The G-tube was put back in place and leakage onto a separate gauze was allowed for thirty minutes. Total leakage from both timeframes was measured and compared. This process was performed for a total of four trial runs. **Results:** From four total test trials, mean leakage values were obtained before and after injections were performed. Pre-injection values for the four trials were 13.46, 10.78, 3.09, and 3.44 grams, while post-injection values for the four trials were 8.07, 6.29, 0.49, and 1.21 grams respectively. The mean value for leakage obtained before injections was 7.693 grams while the mean value obtained post-injections was 4.015 grams. There was a statistically significant difference in levels of leakage before injections compared to levels of leakage after injections; $t(3) = 4.868$, $p = 0.0166$. **Conclusion:** D50 injections in a porcine model proved to be highly successful. Because the injection device is compact and well-designed, it will allow for physicians to quickly and accurately inject the bulking material around the gastrostomy tract. With hopes of moving into clinical use, patients may see rapid and long-term improvement of their leakage levels with these injections. IRB approval for a clinical trial has been approved and will hopefully confirm preclinical data.

79 - LUMBAR LOAD ANALYSIS IN THE SWEEPING GESTURE

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Introduction: Household chores such as sweeping, vacuuming, and mopping are common activities in the home that, due to repetitive movements and forced postures, can lead to overload in the lumbar region. This study focused on evaluating how the broomstick length influences lumbar flexion and perceived exertion as indicators of biomechanical load during the sweeping gesture. The objective was to determine whether an ergonomic adaptation of the broomstick according to the user's height reduces lumbar flexion and perceived exertion, comparing two groups: tall participants (height > 1.70 m) and short participants (height < 1.70 m). **Methodology:** Ten volunteers (7 tall and 3 short) were recruited and performed five sweeping trials over a standardized distance under two conditions: using a standard broom (1.30 m) and a long broom (1.80 m). Participants were instructed to maintain a stable trunk, a straight back, and to move only their arms, avoiding lateral inclination. Data were captured in a motion analysis laboratory equipped with 16 OptiTrack® optoelectronic cameras. Subsequently, OpenSim® software was used to perform inverse kinematics analysis and obtain the lumbar sagittal flexion curve. Angular data were processed using MATLAB®, where descriptive and inferential statistical analyses were applied. Perceived exertion was assessed using the Borg scale (6-20) after each series of sweeping trials. Two phases of the movement were defined: the loading phase (0-60% of the cycle) and the sweeping phase (60-100%), based on previous research conducted by the team. For statistical analysis, the Shapiro-Wilk normality test was applied. Since no group of data presented a normal distribution, Mann-Whitney tests were used: independent tests to compare medians between height groups and paired tests to compare broomstick conditions within the same group, establishing a significance level of $P < 0.05$. **Results and Discussion:** In the group of tall participants, 60% reported lower perceived exertion when using the long broom, with a mean Borg score of 11.2 ± 1.1 compared to 13.5 ± 1.3 when using the standard broom ($P = 0.003$). In

the group of short participants, 40% reported lower exertion with the long broom, while the rest did not perceive significant differences (Borg 12.8 ± 1.0 vs. 12.5 ± 0.9; P = 0.21). Regarding lumbar flexion, tall participants showed an average peak flexion of 112° ± 5° when using the long broom compared to 120° ± 6° with the standard broom during the loading phase (P = 0.01), and 95° ± 4° compared to 102° ± 5° during the sweeping phase (P = 0.02). No significant differences were observed among short participants (P > 0.05). **Conclusions:** The results suggest that adapting the broomstick length to the height of taller users (≥ 1.70 m) can reduce both lumbar flexion and perceived exertion, which may decrease the risk of discomfort and injuries in the lumbar region. However, for shorter individuals, using a longer broom does not provide significant ergonomic benefits. It is recommended to design broomsticks with adjustable lengths to improve individual adaptation. Future studies should consider a larger sample size and explore other relevant postural variables.

80 MAGNESIUM BASED IMPLANTS APPLICATIONS IN ANIMAL MODULES AND CLINICAL STUDIES: A NARRATIVE REVIEW

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The need has risen over the last decade to replace titanium-based implants in bone surgeries. A potential alternative to Ti is magnesium. Magnesium represents a viable option due to its biocompatibility and biodegradability. However, research is still going to determine how to resolve its low-mechanical strength and hydrogen release. The purpose of this narrative review is to compile the latest evidence in literature on magnesium-based-implant for medical uses. Focusing on clinical uses, animal testing and the alloys used to alter its strength, biocompatibility and cytocompatibility. Several databases and journals were searched using different keywords related to Mg-based implants medical applications. It was concluded that Mg-based implants have made great strides recently. Especially in the small animals' modules having positive results and represent, in theory, a capable and suitable alternative to other metals. Mainly due to its biodegradability and biocompatibility. However, these encouraging results do not coincide with the ones reached in clinical applications. As the outcomes of clinical application on Mg-based alloys and implants varies, and the negative results in some do not appear uniform or have a common theme among them. This could be attributed to the low numbers of Mg-based implants clinical studies, when compared to the numbers of pre-clinical studies, lack of long-term trials and low large animals' modules research. The main issues with Mg remain to be its mechanical strength, especially in high-loading areas and its hydrogen release. To overcome said issues, more trials and studies into large animals' modules and clinical applications are much needed alongside trials to determine the long-term effects of Mg-based implants. Additionally, a uniform design of Mg alloys needs to be established between different institutions through coordinated cooperation. If we are to expedite Mg-based implants research in the coming years.

81 - DOPING CONTROLLED METAL HALIDE PEROVSKITE BASED PIEZOELECTRIC ENERGY HARVESTER FOR SELF-POWERED SENSING

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The demand for sustainable and high-performance energy harvesting materials has driven widespread research into lead-free (Pb) halide perovskites as alternatives to conventional piezoelectric materials because of the toxicity of Pb. These materials demonstrate excellent ferroelectric, optoelectronic, and mechanical properties, making them promising nominees for piezoelectric nanogenerators and self-powered devices. However, there are some challenges, including phase stability, charge carrier recombination, and environmental degradation, which hinder their practical applications. This study focuses on improving the piezoelectric performance and stability of the halide perovskites through strategic elemental doping at the A-site and B-site of the perovskite crystal structure. We d the FASnX3 (X=I, Br, and Cl) halide perovskite materials, which have shown potential in piezoelectric energy harvesting applications owing to their tenable electronic structures and enhanced ferroelectric polarization [3][4]. The objective of this work is to optimize the key material properties, including crystallinity, band alignment, charge transport, and piezoelectric response, by introducing suitable dopants and applying them to energy-harvesting devices. Firstly, we have calculated the doped materials' electronic structure modifications, defect formation energies, and polarization characteristics insight through the Density Functional Theory (DFT) calculations. Next, the high-throughput computational data is used to guide machine learning (ML) models able to predict and optimize the material properties, accelerating the discovery of high-performance candidates, especially in energy harvesting applications. Then, based on the ML-guided selection, the effect of doping is determined through a combination of experimental techniques, including X-ray diffraction (XRD), Raman spectroscopy, UV-Vis absorption spectroscopy, and piezoresponse force microscopy (PFM). Our results imply that appropriate doping concentrations of halide perovskite substantially improve the piezoelectric

coefficient (d_{33}), enhance the charge carrier mobility, and decrease the formation of deep-level trap states. These improvements absolutely transform into higher output voltages and current densities in piezoelectric nanogenerators, demonstrating the possibility of doped halide perovskites in self-powered electronics. Furthermore, the stability tests under ambient conditions show that doped halide perovskites demonstrate enhanced resistance to moisture and thermal degradation, which overcomes a vital limitation in their realistic deployment. The suppression of ionic migration, along with stronger lattice interactions, promotes the long-term operational stability of the devices. Moreover, the impedance spectroscopy and transient photocurrent measurements prove that the doped perovskites present lower recombination losses and faster charge transport dynamics, which further improve their energy-harvesting potential. This research depicts a sustainable pathway for enhancing the high-performance halide perovskite-based piezoelectric energy harvesting devices. We specify a scalable strategy to overcome existing challenges related to stability and efficiency by leveraging elemental doping. To the advancement of next-generation perovskite-based nanogenerators, the insights gained from this study contribute to offering promising applications in wearable electronics, self-powered sensors, and environmentally friendly energy harvesting systems.

82 - LONG-ACTING DRUG DELIVERY FROM CORE-SHELL MICROPARTICLES OFFERING PRE-PROGRAMMED AND CUSTOMIZABLE RELEASE KINETICS

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Pharmaceutical drugs have significantly improved longevity and quality of life. As a result, more than half of the world's population takes at least one medication daily. However, traditional drug formulations can result in a short therapeutic duration, toxicity, and poor patient compliance. Clinically approved controlled-release systems have extended the therapeutic efficacy of small molecule drugs; however, the use of these systems is typically limited due to first-order release kinetics and are often incompatible with protein and peptide delivery due to drug instability.

We developed PULSED, an injectable, modular, and pulsatile microparticle system. By combining different PULSED particle populations, each engineered to exhibit pulsatile release at a different time, we demonstrate the ability to customize drug release profiles. Drug payloads are encapsulated within the microparticles' core-shell structure, where degradation of the biodegradable shell triggers sharp, all-at-once release. This design mimics multi-dose regimens with a single injection while preserving biologic activity through fabrication and release.

PULSED microparticles have demonstrated tunable pulsatile release across various timeframes (days to months) through chemical composition and exhibited geometry-based release behavior, enabling both spatial and temporal control of drug delivery. Moving forward, we aim to apply PULSED to improve areas such as immune checkpoint inhibitor delivery, single-injection vaccines, and combination vaccines, leveraging its modular and pulsatile design to enhance treatment efficacy and patient compliance.

83 - NANOPARTICLE-BASED TARGETED THERAPY FOR BONE METASTASES IN PROSTATE CANCER

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Treating bone-metastatic prostate cancer remains a significant clinical challenge, despite the expanding number of drug approvals in recent years. A primary obstacle to improving therapeutic outcomes lies in the inability of current treatments to effectively reach and invade the bone microenvironment, limiting their efficacy. As a result, metastatic lesions in bone often remain unresponsive, while existing chemotherapies can lead to considerable off-target toxicity. Furthermore, many of the approved agents offer minimal benefit to the patient due to minimal improvement in quality of life. To address these limitations, we have developed a novel bone-targeted nanotherapeutic platform designed to enhance the delivery of chemotherapeutics specifically cabazitaxel, to sites of bone metastasis. Our approach utilizes alendronate, an amino-bisphosphonate, as a bone-targeting ligand on the nanoparticle surface to facilitate precise accumulation within the bone microenvironment. This strategy aims to increase the local drug concentration at metastatic sites, thereby improving therapeutic efficacy while reducing systemic side effects. This targeted nanoparticle system holds promise as a next-generation therapeutic approach for bone-metastatic prostate cancer, with the potential not only to reduce tumor burden but also to significantly improve patient quality of life.

84 - BREAKING BARRIERS: ADDRESSING THE UNDERREPRESENTATION OF WOMEN IN STEM CAREERS

Jan Duncan

Texas College

This presentation explores the persistent underrepresentation of women in STEM (Science, Technology, Engineering, and Mathematics) fields through a narrative lens that combines data-driven insights with personal stories and systemic analysis. Drawing from historical context, current workforce statistics, and lived experiences, the presentation highlights the multifaceted barriers women face—from early educational biases to workplace discrimination and lack of mentorship. Through the study of compelling case studies and interviews with female STEM professionals, the audience is invited to reflect on how societal norms, institutional structures, and unconscious biases continue to shape the career trajectories of women. My session emphasizes the urgent need for cultural change, inclusive policies, and proactive support systems to create equitable opportunities. Ultimately, the presentation serves not only as a call to action for educators, employers, and policymakers but also as an empowering platform for envisioning a future where women are fully represented and valued in all areas of STEM.

85 - IN-SILICO DESIGN OF THERAPEUTIC PEPTIDES TO PREVENT INSULIN AGGREGATION

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Diabetes is a growing health concern for individuals across the globe. A large population used insulin protein injections to control blood sugars, which sometimes lead to higher chance of aggregation, forming toxic products. Designing a protein with therapeutic effect proved to be an expensive task with a cosmic searching space, with 20 common amino acids making up human proteins and hundreds in nature. This study used protein-ligand docking software (Autodock Vina and Cluspro) and 3D structure generation of the proposed peptide sequence through AlphaFold 2. The protein-protein interaction aided the optimization of protein sequence while searching for the best candidates that inhibit insulin aggregation. The protein sequences were randomly chosen in one approach, and their structures were then generated from AlphaFold2. The polypeptides with acceptable confidence metrics are then docked into insulin using Autodock Vina or Cluspro. The second, more manual approach, we designed protein sequences based on mutual interactions between Human Serum Albumin (HSA) and Insulin docking results. The designed polypeptides show similar mutual interactions with insulin, compared to insulin-insulin interactions. We also applied machine learning to predict the docking score of sequences without the structure by AlphaFold2, to investigate whether the process can be accelerated. Our approach in utilizing docking tools and the Nobel-prize-winning AlphaFold 2 program to generate a target peptide sequence can be extended to design therapeutic peptides that interact with other proteins, such as beta-amyloid or essential biomolecules. With the advancement of machine learning algorithms and biotechniques such as Cryo-EM and affinity assays, our work can be elevated with a higher success rate over time, with a better dataset and combination of experimental results in a short period.

86 - FREE PIOGLITAZONE AND ECHOGENIC PIOGLITAZONE-LOADED LIPOSOMES INHIBIT TGF-BETA-MEDIATED CONVERSION OF FIBROBLASTS TO MYOFIBROBLASTS, A CRITICAL STEP IN FIBROSIS DEVELOPMENT

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Background. Several forms of pulmonary fibrosis result from a process in which M2 alveolar macrophages are induced to secrete transforming growth factor-beta (TGFβ), causing fibroblast conversion to myofibroblasts. This is a critical step in producing lung fibrosis. The PPARγ agonist pioglitazone (PGN) has been found to inhibit TGFβ-dependent pathways. We have developed PGN-loaded echogenic liposomes (Atheroglitatide, AGT), an ultrasound (US)-responsive controlled release drug nanocarrier. In this study, we sought to confirm PGN inhibition of TGFβ-induced fibroblast to myofibroblast conversion and to test whether AGT is also effective in this regard. **Methods.** Cultured NIH-3T3 mouse fibroblasts were treated with 10ng TGFβ/ml for 2 days to induce transformation into myofibroblasts. The cells were then treated with various concentrations of PGN, AGT, or empty echogenic liposomes (ELIP) as controls. Cell lysates were subjected to Western blots for alpha smooth muscle actin (αSMA, a myofibroblast marker). Cell proliferation was measured with the WST-1 assay. **Results.** Significant increases in fibroblast αSMA expression were observed after TGFβ addition; the increase was blocked by ≥ 30 μg PGN/ml. Increases in fibroblast proliferation, another indication of myofibroblast transformation, were also observed after TGFβ addition and blocked by 15 μg PGN/ml and by AGT containing 53 μg PGN/ml. **Conclusions.** Free PGN inhibited TGFβ-induced myofibroblast conversion and PGN-loaded ELIP retained that property. This suggests that AGT may have utility in treating pulmonary fibrosis disorders.

87 - SYNTHESIS AND CHARACTERIZATION OF DEGRADABLE POLYMERIC MICROPARTICLES FOR DRUG DELIVERY

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Environmental pollution from polymeric waste has become an escalating concern, with an estimated 6.3 billion tons of polymeric waste generated since 1950 [1]. This waste presents significant environmental risks, contributing to global warming and ultimately impacting human health. Polymeric materials are essential across various industries, including pharmaceuticals and drug delivery, highlighting the need for sustainable disposal methods to mitigate environmental impact. One promising approach is the development of degradable polymeric materials, which offer benefits such as minimizing the need for revision surgeries in drug delivery applications and reducing polymeric waste. This project synthesizes polymeric microparticles with degradable linkers to enhance the degradation rate for controlled drug delivery applications.

Microparticles were made using suspension polymerization. While stirring the aqueous phase (water and Hitenol) at 500 rpm, we added an organic phase (2-ene or a proprietary degradable linker, 2-thiol, 4-thiol, and photoinitiator) and cured using UV light for 10 min. The liquid was then decanted. An ethanol soak was performed to remove the solvent, and the microparticles were rinsed in deionized water. Our control group contained 2-ene, and our experimental groups contained the degradable linker. Pictures of the particles were taken using a Keyence optical microscope at 20x magnification. Microparticles were placed in 5 mL phosphate-buffered saline (PBS). Using a Nanodrop Spectrophotometer, PBS was tested for degradation components using UV-vis spectroscopy by measuring the absorbance at 247 nm. Data and error bars were reported as mean □ 95% confidence intervals. Results with p □ 0.05 are deemed significantly different.

Microparticles of similar size (diameter ~ 100-200 μm) were formed in the control group, which lacked the degradable linker, and in the experimental groups, which contained the degradable linker. Microparticles in the control group retained their structural integrity after five days of soaking in PBS. In contrast, microparticles containing the degradable linker exhibited substantial morphological changes, losing their original shape and forming a white film by day 5. These observations confirm that including the degradable linker significantly accelerates the degradation rate. Degradation products were detected at an absorbance peak of 247 nm, with degradation observed between days 1 and 7 across all groups. Our quantitative results indicate that incorporating a degradable linker into the formulations significantly increases the degradation rate compared to the control, which lacked the degradable linker. For example, the formulation with an 80% degradable linker produced twice the amount of degradation products relative to the control group. Degradation was influenced by media pH, with neutral to basic conditions favoring degradation over acidic conditions. The microparticles would remain at a target site longer in more acidic conditions, benefiting bacteria-infected sites because the pH environment tends to become more acidic. Additionally, frequent media changes enhanced degradation by preventing media saturation with degradation products. When the media is saturated, degradation stops and continues after the media changes.

These findings suggest that the chemical environment and media handling can significantly affect the degradation rate, which may be leveraged to optimize controlled degradation in drug delivery applications.

88 - POLYMERIC NANOPARTICLE DRUG DELIVERY FOR ANTIOXIDANT-MEDIATED ROS REDUCTION IN A CISPLATIN-INDUCED IN VITRO OTOTOXICITY MODEL

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Background: Elevated reactive oxygen species (ROS) play a critical role in cisplatin-induced ototoxicity, leading to permanent auditory cell damage and hearing loss. Current therapeutic options are limited by poor drug delivery efficiency and nonspecific targeting. Nanomedicine offers a promising strategy to enhance targeted delivery of antioxidants for inner ear protection. **Objective:** This study aims to develop and evaluate a polymeric nanoparticle-based drug delivery system for targeted reduction of intracellular ROS in cisplatin-induced ototoxicity. We seek to enhance delivery precision, optimize ROS scavenging, and quantitatively validate therapeutic effects in a cisplatin-induced ototoxicity model using HEI-OC1 cells. **Methods:** We established an in vitro model of ototoxic injury by treating HEI-OC1 cells with cisplatin to induce ROS production. Polymeric nanoparticles, both with and without encapsulated antioxidants, were synthesized and applied to the injured cells. The efficacy of drug delivery was determined by

measuring the reduction in intracellular ROS levels. ROS levels were quantitatively assessed using a genetically encoded fluorescent biosensor developed in Dr. Newman's lab. To further validate and standardize the evaluation process, we developed an AI-based image analysis platform to precisely quantify ROS fluorescence as an indicator of cellular oxidative stress and potential hearing damage. **Results:** Application of antioxidant-loaded nanoparticles resulted in a significant reduction of ROS levels in cisplatin-injured HEI-OC1 cells compared to both untreated controls and cells treated with nanoparticles lacking antioxidants. The AI-based imaging analysis provided robust, reproducible quantification of ROS reduction, confirming the enhanced drug delivery efficiency of the antioxidant-loaded nanoparticles. **Conclusion:** This work demonstrates the potential of polymeric nanoparticles for targeted antioxidant delivery and ROS reduction in vitro model of cisplatin-induced ototoxicity. The integration of advanced biosensor technology and AI-driven image analysis establishes

89 - COMPUTATIONAL PREDICTIONS OF POSITIVE ALLOSTERIC MODULATOR BINDING SITES IN HIGH-SENSITIVITY (A4)2(B2)3 NICOTINIC ACETYLCHOLINE RECEPTORS USING PAM-BOUND CRYO-EM STRUCTURES

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Positive allosteric modulators (PAMs) of nicotinic acetylcholine receptors (nAChRs) have potential therapeutic applications for neurological disorders by enhancing receptor functions and modulating neuronal activities. The number and locations of allosteric binding sites within the high-sensitivity (α4)2(β2)3 nAChR, a major subtype that plays a crucial role in cognitive and reward pathways, have not been mapped yet. A recent Cryo-Electron Microscopy study has resolved structures of α4β2 nAChR bound to ACh and calcium as representative of PAM-bound α4β2 nAChRs. We employed computational docking using the CDOCKER module in Discovery Studio to identify PAM-binding sites in (α4)2(β2)3 nAChR. First, we validated the merit of this docking methodology by comparing agonists' docking energies at the orthosteric α4:β2 extracellular interface to their experimental data. Then we docked PAMs with diverse structures (C9M, dFBr, LY1078101, and their analogues) at potential allosteric pockets within the (α4)2(β2)3 nAChR structures that were resolved in the presence of ACh (± calcium, a nAChR PAM; PDB# 8SSZ and 8ST0), nicotine (PDB# 6CNJ), or varenicline (PDB# 6UR8). C9M exhibited the highest docking energy, consistent with experimental data. The agonist co-crystallized with (α4)2(β2)3 nAChR influenced PAM docking energy. In contrast, the presence of calcium (8SSZ vs. 8ST0) had no effect on docking at the α4:β2 and β2:α4 transmembrane interfaces. Future research will explore the relationship between agonist co-crystallized with (α4)2(β2)3 nAChR and the molecular interaction of docked PAM with amino acid residues forming the allosteric sites. Altogether, this helps us better understand nAChR allosteric conformations and enhances the structure-based design of nAChR PAMs.

90 - THERAPEUTIC POTENTIAL AND UPLC-ORBITRAP MASS SPECTROMETRIC PROFILING OF WATERCRESS LEAF EXTRACTS

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Watercress (*Nasturtium officinale*), a Brassicaceae family vegetable, is known for its therapeutic properties against disorders such as hypertension, cancer, hepatic diseases, and hyperglycemia. These benefits are attributed to its phytochemical constituents, including flavonoids, polyphenols, and phenyl isothiocyanate. This study investigates the antioxidant potential of methanolic watercress leaf extracts and their ability to protect human serum albumin (HSA) from oxidative damage. Oxidative stress was induced using hydroxyl radicals (via Fenton reaction) and dehydroascorbic acid. Structural changes in HSA were analyzed using UV/Vis, fluorescence spectroscopy, CD, ATR-FTIR, and gel electrophoresis. Results revealed that watercress extract, especially in combination with kaempferol, effectively scavenged radicals and preserved HSA structure. To identify active compounds, methanolic, ethanolic, and aqueous extracts were analyzed using HPLC with varying mobile phases. Total flavonoid content (TFC), antioxidant capacity (TAC), and phenolic acid content (TPAC) were evaluated. UPLC-Orbitrap MS was used for phytochemical quantification, and ddMS² confirmed compound identities. Calibration curves ranged from 2.5-1000 ng/mL with high linearity ($R^2 > 0.99$). Preliminary studies in ovarian cancer cells demonstrated watercress's oxidative protective effects. These findings support the potential of watercress-derived compounds as natural antioxidants for therapeutic use.

91 - GAMIFIED EMG TRAINING FOR PROSTHESIS CONTROL: IMPACT OF MULTIPLAYER MODES ON ENJOYMENT AND SOCIAL ENGAGEMENT

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Serious gamified training presents unique and engaging opportunities for rehabilitation and targeted muscle strengthening. Electromyography (EMG) is a technique that records specific muscle flexions using electrodes placed on the surface of the skin. These electrical signals can be translated to control a device, such as a prosthesis. However, EMG prostheses require precise control of target muscles for actuation, which introduces usability difficulties. Frustrations with functionality can lead to prosthesis rejection and deter potential users.

Proper and regular training facilitates the strengthening of muscles required for EMG prosthesis control. Training can be integrated prior to prosthetic introduction to increase the utility of the device. Gamified training can be utilized to create engaging experiences for users and has been proven to facilitate faster and easier prosthesis control. EMG training games focus on elements of muscle contraction control, such as hitting a strength threshold or discriminating between contraction intensities. Exercises supported by a game can strengthen and coordinate muscles and encourage better prosthesis control. To promote adherence to training, games must be engaging and enjoyable. Existing literature supports an increase in enjoyment and social connectivity in multiplayer game modes compared to solo gameplay. This may be due to shared experiences and a sense of belonging when interacting with fellow players. This study aims to determine whether multiplayer interactions in EMG training games also increase user enjoyment, engagement, and social presence.

Limbitless Redline is a multiplayer side-scrolling motorcycle racing game that combines elements of combat and classic racing. Players control a motorcycle's speed and steering to maneuver around obstacles and other players. The EMG controller on a player's forearm records the magnitude of targeted muscle flexes, which translates to motorcycle acceleration. A secondary handheld 8BitDo micro gamepad manages the steering of the motorcycle. Up to four participants can play the game simultaneously, which introduces a unique social factor into an EMG training game. Enjoyment, social connectivity, usability, and performance will be recorded for participants in 4 cohorts with 1, 2, 3, or 4 players, respectively. These measures will be assessed using the Game User Experience Satisfaction Scale (GUESS), Social Presence in Gaming Questionnaire (SPGQ), and System Usability Scale (SUS). Observing and analyzing trends for these measures will help determine whether the number of players that participants engage with influences outcomes. Enjoyment, social connectivity, usability, and performance are all expected to increase as cohort size increases due to elevated feelings of belonging from player interactions. A total of 40 participants are expected to be in the research study.

Insights from this study will help determine whether enjoyment and social connectivity trends in EMG prosthesis gamified training are consistent with existing literature. Future work may include integrating *Limbitless Redline* into clinical training protocols as a platform to enhance EMG functionality. Implementing appropriate multiplayer capabilities, such as multigenerational play, may help improve adherence to training methods and the overall patient training experience.

92 - MITOCHONDRIAL DYSFUNCTION AND MALADAPTIVE CARDIAC REMODELING ASSOCIATED WITH METHAMPHETAMINE-INDUCED CARDIOMYOPATHY

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Introduction: Methamphetamine (METH) abuse is a major public health concern, with cardiovascular complications a leading cause of mortality. The molecular and histopathological mechanisms underlying METH-induced cardiomyopathy remain poorly defined. **Objectives:** We investigated cardiac fibrosis, hypertrophy, and mitochondrial dysfunction in human METH users and a murine model of 'binge' METH exposure. **Methods and Results:** Autopsy-derived left ventricular (LV) tissues from chronic METH users demonstrated pronounced perivascular and interstitial fibrosis by Sirius Red and Masson's Trichrome staining. In mice, four weeks of 'binge' METH administration increased heart weight-to-tibia length ratios, cardiomyocyte cross-sectional area (WGA staining), and LV fibrosis. Mitochondria isolated from METH-treated hearts exhibited impaired bioenergetics

assessed via Seahorse analysis. Immunoblotting revealed altered expression of mitochondrial dynamics regulators. METH exposure of neonatal rat ventricular cardiomyocytes suppressed mitochondrial respiration and disrupted mitochondrial network organization, suggesting direct cardiotoxicity. **Conclusions:** Chronic METH exposure promotes maladaptive cardiac remodeling characterized by fibrosis, hypertrophy, and mitochondrial dysfunction, implicating mitochondrial impairment as a key driver of METH-induced cardiomyopathy.

93 - SELF-ASSEMBLING PROTEIN AND PEPTIDE SYSTEMS AS SCAFFOLDS FOR DRUG DELIVERY, NANOMEDICINE, AND DRUG DISCOVERY.

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The self-assembly of proteins into multicomponent structures is an amazing feature of biologic systems. Protein self-assembly is mediated by molecular surfaces on protein subunits that associate through complementary non-covalent interactions, often through short peptide sequences that make up the larger protein structure. Interest in self-assembling protein and the smaller peptide components has been extensive for their use in constructing new nanomaterials for drug delivery and mediating molecular interactions for probing important questions in drug discovery/delivery. The research presented here provides an overview of research utilizing and developing self-assembling protein and peptide systems for use in drug delivery and drug discovery applications. Three areas of study are currently underway that are focused on: 1) utilizing virus-like particles (VLPs) as nanomaterials for drug delivery, 2) Design of molecular building blocks (MBBs) from peptides for constructing new nanomaterials, and 3) exploiting peptides to direct protein-protein interactions for probing questions in therapeutic design. Studies in VLPs focus primarily on utilizing the bacteriophage HK97 as a versatile nanoscaffold that can be chemically programed for drug delivery of various molecular cargoes. MBB studies have focused on synthesizing peptides that can be systematically assembled in a stepwise manner toward controlling the size and morphology of designer nanomaterials to be used as new scaffolds for therapeutic applications. Lastly, investigations of short peptides for mediating protein-protein interactions is presented as an approach for investigating drug applicability *in vitro* on desired protein domains.

94 - MOLECULAR MECHANISMS AND NANO-PARTICLE DRUG DELIVERY SYSTEMS TO COMBAT DOXORUBICIN CARDIOMYOPATHY

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Chemotherapy-associated cardiotoxicity poses an unmet challenge for the successful prognosis of cancer. Cardiotoxicity triggered by non-specific distribution of small molecular anticancer drugs is mostly mediated by their effects on cardiac myocytes, vascular endothelium, hemodynamic flow alterations, and thrombic events. Since their discovery more than 50 years ago, anthracyclines (e.g., Doxorubicin (Dox)) have become the mainstay for treating many childhood and adult malignancies, but are reported to develop cardiomyopathy. Despite extensive studies, whether Dox induces autophagy activation/inhibition remains elusive, and whether autophagy dysregulation contributes to mitochondrial dysfunction in Dox-cardiotoxicity remains unclear. We hypothesized that Dox-mediated impaired autophagy degradation process contributes to mitochondrial dysfunction, ensuing in the development of cardiomyopathy. We assessed temporal changes in autophagy in mouse models of acute- and chronic Dox-cardiomyopathy using genetic reporter mice to monitor autophagy. Our study confirmed that both acute and chronic Dox-cardiotoxicity are associated with the accumulation of autophagosomes resulting from the inhibition of the autophagic degradation process. We also found suppression of mitochondrial respiration in both acute and chronic Dox-treated mice. To abrogate Dox-associated cardiotoxicity, we developed a polymeric Dox nanocarrier that releases the drug only in the cancer microenvironment. We found that covalent conjugation of Dox to a pH-sensitive nanocarrier significantly reduced the cardiotoxicity of Dox in cardiomyocytes. Our studies suggest that the appropriate selection of the nanocarrier for Dox delivery may abrogate cardiotoxicity and trigger the chemotherapeutic potency of Dox.

95 - HAND DEXTERITY EVALUATION IN VIRTUAL REALITY: A FRAMEWORK FOR SENSORIMOTOR ASSESSMENT

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Virtual reality (VR) is a versatile tool with potential for integration into healthcare contexts, from therapeutic interventions to diagnostic applications. For upper-limb electromyographic (EMG) prostheses, the successful adoption of the device depends on functional prosthesis control and user dexterity. Limited functionality and control difficulties result in prosthesis rejection, emphasizing the

need for reliable and accessible dexterity assessments that facilitate long-term user training and monitoring.

This study investigates the translation and implementation of established hand dexterity assessments into a VR environment. The Box and Block Test (BBT) and Modified Box and Block Test (MBBT) were selected based on their established validity and clinical acceptance in traditional physical environments. Both assessments involve a setup of standardized wooden blocks in a box consisting of two compartments with a partition between them. The BBT measures the number of blocks transferred from one compartment to another within one minute. The MBBT measures the time required to transfer 16 evenly spaced blocks from one compartment to another.

This investigation is a continuation of a study assessing the physical BBT and MBBT, which established dexterity baselines in a college-aged population (n=50). The digital adaptations of the BBT and MBBT were integrated into an immersive VR platform. The primary objective was to assess these virtual assessments and establish preliminary VR baselines. In the VR environment, elements of the BBT, including the box, blocks, and hands, were scaled to their physical counterparts. Additionally, the VR assessment implemented physics-based hand interactions with the blocks. Haptic feedback from the handheld controller was included to indicate virtual contact with a block. Mechanics that target gross movement of users by utilizing an area of collision to detect blocks within a set radius around the in-game hand were implemented. This fosters simplicity for first-time VR users to produce outcomes closer to the physical tests.

BBT and MBBT performance in the VR environment (n=10) was compared to the physical environment, and preliminary results indicate a consistent decrease in performance in VR compared to the physical testing. Performance differences may have occurred due to VR inexperience or the increased cognitive workload associated with VR. Analysis of secondary metrics, including grip strength and hand dominance, revealed no statistically significant correlation with VR performance, mirroring findings in traditional contexts.

This research establishes the practicality of VR-based dexterity assessments, creating opportunities for VR in prosthetic rehabilitation and clinical care. VR environments have increased user engagement and motivation, making rehabilitation exercises more appealing and holding potential to improve adherence. VR-based training also demonstrates a potential for transference, enabling skills learned in VR to translate to real world scenarios. VR holds potential with adaptive difficulty levels, providing progressively challenging tasks which can be tailored to user performance and maintain an optimal difficulty. Future work includes exploring embodiment in VR, where a virtual limb can be perceived as an extension of the user's body to improve motor learning.

96 - HARNESSING LICHEN ACIDS FOR TARGETING TRIPLE-NEGATIVE BREAST CANCER

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Lichens are unique and complex organisms formed through a symbiotic relationship between a fungus (the mycobiont) and an alga or cyanobacterium (the photobiont). Lichens produce a wide array of unique secondary metabolites for various roles. These biomolecules not only help lichens endure environmental stress but also have attracted scientific interest for their potential pharmaceutical applications. Triple-negative breast cancer (TNBC) is an aggressive subtype of breast cancer characterized by the absence of estrogen receptors (ER), progesterone receptors (PR), and human epidermal growth factor receptor 2 (HER2). Lack of such targetable receptors renders TNBC irresponsive to standard hormonal therapies or HER2-targeted treatments, making it more challenging to treat than other breast cancer subtypes. Therefore, continued research is essential to better understand TNBC biology and to develop more effective, and offer personalized treatment options. Our group has leveraged two lichen acids in the development of lead compounds targeting TNBC. Norstictic acid, a depsidone, significantly attenuated TNBC cell proliferation, migration, and invasion by modulating the protooncogene receptor tyrosine kinase c-Met. Furthermore, norstictic acid demonstrated impressive *in vivo* efficacy in orthotopic TNBC animal models with significant reduction in tumor burden. On the other hand, we identified the anti-TNBC effect of unsic acid, a lignan-like lichen-derived polyketide, to be mediated through inhibition of the mechanistic target of rapamycin (mTOR). Building up on this discovery, we employed a rational drug design strategy to semiynthesize several usnic acid analogs, achieving enhanced potency with activity in the nanomolar range. In conclusion, lichens offer a valuable source of bioactive molecules with significant potential for TNBC treatment. As our research continues, these lichen-derived compounds may pave the way for novel, targeted therapies, offering hope for more personalized and effective treatment options for untreatable TNBC patients.

97 - MITOCHONDRIAL FUNCTION RESTORATION AS A POWERFUL THERAPEUTIC AVENUE IN ATHEROSCLEROSIS

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M1 macrophages sustain a pro-inflammatory microenvironment that drives atherosclerotic plaque progression. Dysregulated metabolism in the form of increased glycolysis in macrophages accompanies their M1 polarization. The objective was to target inflammation in atherosclerotic plaques by inducing favorable bioenergetics in M1 macrophages. The hypothesis was that mitochondrial transfer to atherosclerotic plaques could regulate M1 macrophage metabolic phenotypes, lessening inflammatory processes and preventing atherosclerotic plaque progression. Mitochondrial transfer to M1 macrophages affected cell bioenergetics, resulting in enhanced oxygen consumption rate and reduced glycolytic flux that coincided with a diminished inflammatory response. Upon intravenous delivery to ApoE$^{-/-}$ mice fed a high fat diet, mitochondria accumulated in aortic plaques and co-localized with macrophages, leading to reduced plaque burden. Notably, cholesterol levels, as well as hepatic steatosis and inflammation, improved. Findings highlight that targeting mitochondrial dysfunction in plaque M1 macrophages represents a viable treatment strategy against atherosclerosis, underlining the potential for macrophage metabolic regulation as a therapy in other diseases.

98 - THIOL-CLICKABLE GELATIN-BASED HYDROGELS FOR 3D CELL CULTURE

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Osteoarthritis (OA), a degenerative disease causing joint pain and stiffness, affects about 73% of adults over the age of 55. While symptoms can be managed with non-steroidal anti-inflammatory drugs (NSAIDs), rehabilitation, and surgical intervention, the mechanisms behind OA initiation and progression are not well understood, and there are no currently available treatments effective in reducing or reversing disease progression. Direct characterization of chondrocyte behavior within a biologically relevant *in vitro* platform will aid in our understanding of OA pathology and drive future therapeutic development. Although covalently cross-linked gelatin hydrogels have been investigated for use in 3D cell culture due to inherent bioactivity and proliferation within the denatured collagen precursor, the stability of the matrix, and relatively inexpensive synthesis, current systems lack precise control over mechanical properties, including homogeneity, stiffness, and efficient diffusion of nutrients to embedded cells. Difficulties in modifying gel matrix composition and functionalization have limited the use of covalently cross-linked gelatin hydrogels as a 3D cell culture medium, lacking the ability to tailor the microenvironment for specific cell types. In addition, the currently utilized chain-growth photopolymerization mechanism for cross-linking hydrogels has a potential for side reactions between the matrix backbone and components of the cell surface, requires a high concentration of radicals for initiation, and only cures with long irradiation times, which could lead to cytotoxicity. To overcome these limitations, we propose to employ an efficient, superfast curing reaction mechanism, in which a wide variety of thiol monomers react efficiently with non-homopolymerizable alkenes, reliably producing a well-defined matrix that does not require a large radical concentration for photoinitiation. Previous work has narrowly focused on cross-linking the gelatin matrix with a single thiol moiety, decane dithiol (DTT), although mechanical and functional customization of the hydrogel is largely achievable through variations in the length and branching (ex: tri- and tetra- thiols) of the precursors. Our current research aims to develop thiol-clickable, gelatin-based hydrogels for use in 3D cell culture, providing a versatile, ECM-mimetic platform for studying chondrocyte cell physiology, novel drug screening and toxicity testing *in vitro*, and therapeutic applications in regenerative tissue engineering.

99 - STANDARDIZING EVALUATION FOR MULTI-GESTURE CONTROL TRAINING AND USABILITY FOR ELECTROMYOGRAPHIC PROSTHESIS

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Continued improvements to upper limb prostheses are focused on increasing device functionality to meet the demands of activities of daily life (ADL). EMG devices have gained favorability due to their performance and aesthetic options. Current research is working to address weight and functionality as the primary contributors to rejection rates in order to improve usage. Specifically, lack of functionality is cited as a significant factor in upper limb prostheses rejection rates; thus, there is a need to assess and expand physical capabilities with EMG prostheses. Despite the growing availability of myoelectric devices, there is little data providing insight into how many gestures can be feasibly handled by novice users compared to experienced users. With more gestures to perform, there may be a tradeoff between the training time and cognitive workload required to differentiate various controls. Currently, serious gaming is being utilized in ongoing clinical trials to prepare individuals for using EMG upper limb prostheses. Video games with the primary intention of training have already

shown promise in improving usability and performance outcomes. This study explores performance and perceptions with a maximum of five distinct surface EMG gestures in one session. Average scores out of 15 per trial, perceived usability, and perceived cognitive workload were compared amongst cohorts. A training and evaluation instrument was developed based on pre-existing calibration app technology to evaluate multi-gesture performance. This device, called a flex controller, uses embedded surface electrodes that pick up distinct muscle activity. First-time EMG users with full muscular control of their upper extremities were randomly placed in one of four cohorts. Cohorts differ in the number of distinct zones of control: Cohort A1 has one zone, Cohort A2 has three zones, and Cohort A3 has five zones. These three cohorts keep the same number of zones for all three trials. Cohort B1 requires the user to complete one trial of the one, three, and five zone modes. Each zone, outlined with a minimum and maximum threshold of muscle flexion intensity, triggers a different gesture on the prosthetic device. The participants each completed three rounds of 15 randomized cues to assess performance and accuracy among the four cohorts. Preliminary data analysis indicates comparable average scores from the progressive cohort B1 to the respective trial of the matching single-mode cohort. Scores from the System Usability Scale indicate that cohorts A2 and B1 have the highest perceived usability. Lastly, the NASA Task-Load Index indicated that perceived cognitive workload is highest among cohort A2. Overall trends support the implementation of three gestures with a progressive mode of training. This would strike a balance between challenge and progression, addressing the demand for increased functionality while retaining device accuracy. Continued work will contribute to helping researchers standardize initial capabilities and progression among future device users.

100 - LIMBITLESS JOURNEY: ADVANCING LOW STRESS HANDS-FREE MOBILITY TRAINING THROUGH VR AND MR GAMING

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Virtual reality (VR) and mixed reality (MR) have been used in a variety of healthcare applications, including for rehabilitation purposes. Previously, Limbitless Journey, a low-stress gamified platform, was demonstrated to be an efficient training system within a desktop modality. The integration of Limbitless Journey into a VR/MR system using the Meta Quest 3 headset can act as a fully immersive version of the game for users. The MR mode allows users to transition between the VR version of the game to the real-world application, allowing for game assets to be displayed in the user's natural environment. This may help provide a seamless integration for users who will then be using an EMG-Wheelchair interface in the real world.

Neurodegenerative disease, stroke, and quadriplegia are among many conditions that impact motor function. Oftentimes, this leads to a reduction in autonomy and independence after diagnosis due to disease progression. Project Xavier is an interface that can be placed on powered wheelchairs for hands-free joystick control. This novel interface collects signals from temporalis muscle flexions via an EMG electrode, which translates to motor outputs that control the wheelchair. A "hard" flex of the muscle corresponds to a forward movement of the wheelchair, a "medium" flex to a right movement, and a "light" flex to a left movement. The muscle discretizations required to properly operate this system may be challenging to master. Limbitless Journey was created to provide a training platform for users prior to real-world usage of the wheelchair interface. The game moves in-game characters via the same flexes and controls as the wheelchair.

For VR, the game works as an analog of the mobility device controls, with the key difference being a lack of eye tracking; a head-mounted raycast is used instead for UI selection. The VR environment aims to improve in-game immersion through a first-person POV. Since MR is mixed into real life, the entire scene must be initialized dynamically at the start of runtime. By combining the room scanning feature that Meta headsets provide with the mobility controls for placing down objects within the scene, we can achieve a new type of game that provides new training opportunities.

In the MR scene, portals from the original game spawn around the MR scene, and coins are generated periodically between portals. This automatic placement is done by combining Unity's NavMesh API and in-house algorithms that try to spread out portals around the room and trace a path between portals for the coins.

These new techniques allow the research instrument to gradually bridge the gap between the very low stakes environment of Journey on desktop to the higher mobility control requirements of the physical world. The progression includes starting on the desktop version, then moving to VR, then MR in the wheelchair, and finally into real life with the wheelchair.

101 - TARGETING CD44 RECEPTORS IN THE LUNGS BY LIPOSOMES ENHANCES HOST IMMUNITY AGAINST TUBERCULOSIS

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Introduction: Tuberculosis (TB), due to Mycobacterium tuberculosis (Mtb) infection, continues to cause more than one million deaths per year, worldwide. TB mitigation strategies are limited to the BCG vaccine for prevention, that shows poor efficacy against pulmonary TB, or lengthy treatments with multiple antibiotics, linked to development of antibiotic resistant TB strains. Therefore, there is a need for new therapies with more resilient TB control. Innate host immunity plays an important role in controlling TB. Recent clinical and *in vivo* studies emphasize the role of innate cells in host defense against TB. Macrophage (MΦ) have been proposed as a target for host-directed therapies (HDT). CD44 is a surface receptor reported to be a binding site for Mtb and to mediate MΦ recruitment in TB. Based on the **hypothesis** that CD44 pathway is an important target in HDT, we designed and tested liposomes (LIP) targeted to CD44 receptors using thioaptamers (CD44TA). We further assessed CD44TA-LIP as HDT, evaluating the killing of Mtb *in vitro* and *in vivo* and boosting host immunity against TB. **Material and Methods: (1)** *CD44TA-LIP were formulated* using a microfluidic device, Nanoassemblr. CD44-TA was conjugated to LIP via EDC/NHS crosslinking (Fig 1A). CD44TA-LIP were characterized for size distribution, polydispersity index (PDI), and zeta potential by Dynamic Light Scattering and visualized by Atomic Force Microscopy. **(2)** *In vitro efficacy and evaluation of mechanisms* were carried out in human MΦ isolated from buffy coats and infected with Mtb H37Rv. For pretreatment or concurrent treatment groups, CD44TA-LIP were incubated with MΦ (10µg/10e6 MΦ) prior to infection or together with Mtb infection, respectively. Bacterial burden (colony forming units, CFU) was measured at day 7 post infection and compared to no LIP treatment control **(3)** For *Biodistribution* analysis, lung inflammation, mimicking TB associated inflammation was generated in C57BL/6 mice with Lipopolysaccharide (LPS) inhalation. Cy5.5 tagged CD44TA-LIP were intranasally administered 24h post-LPS, and mice were sacrificed at 2, 4, and 24h after administration. Fluorescent signal was assessed in the major organs with IVIS, quantified based on the signal intensity with IVIS software, and compared to PBS treated control. **(4)** *In vivo efficacy studies* were carried out in 4-6-week-old C57BL/6 mice infected with ~100CFU Mtb. Pre-treatment (5nM CD44TA-LIP 1 week prior to Mtb infection) and concurrent treatment (5nM CD44TA-LIP together with Mtb infection) were compared to untreated control. Mice were sacrificed on day 28 with lungs and spleens isolated for bacterial burden count. **Results and Discussion:** (1) CD44TA-LIP had a narrow size distribution with average diameter of 204.9 ± 6.3 nm and a negative zeta potential of -22.8 ± 1.9 mV. (2) *In vitro* efficacy studies showed that CD44TA-LIP induced sustained and significant killing of Mtb in human MΦ up to 7 days versus untreated controls cells in both concurrent treatment and pretreatment settings (Fig 1B). (3) In biodistribution studies, predominant concentration of CD44TA-LIP in the lungs was detected. Increasing over time fluorescent signal was observed in the clearing organs: liver and kidneys, possibly associated with LIP clearance. (4) CD44TA-LIP intranasal administration post-Mtb infection in mice resulted in greater than 10 times reduction in CFU in lungs. **Conclusions:** CD44TA-LIP activation of the CD44 signaling pathway enhanced innate immunity in MΦ, aiding in protective immune responses against the pathogen. CD44TA-LIP has potential to be utilized as a novel therapeutic regimen against Tuberculosis.

102 - TIME-RESOLVED RAMAN SPECTROSCOPY WITH GATED DETECTION FOR ANALYSIS OF BIOLOGICAL TISSUES

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This work presents the development and application of a time-resolved gated Raman spectroscopy system aimed at suppressing fluorescence and enabling accurate Raman signal detection in highly fluorescent biological samples. The system integrates nanosecond-gated intensified CCD (ICCD) cameras with picosecond pulsed lasers, allowing precise temporal control to distinguish instantaneous Raman scattering from delayed fluorescence emissions.

Several ICCD cameras and laser configurations were evaluated to optimize gate widths, pulse durations, and delay timing. Gating windows as narrow as 3-5 nanoseconds were successfully implemented, enabling clear temporal separation of overlapping signals. Initial validation using non-fluorescent silicon and hydroxyapatite samples demonstrated the system's capacity to isolate Raman signals with high fidelity.

When applied to extracted human teeth—known for strong fluorescence under 532 nm excitation—the system yielded three key discoveries: (1) clear detection of Raman peaks, such as the 960 cm^{-1} mineral signal, above the suppressed fluorescence background; (2) distinct temporal offsets between peak Raman and fluorescence intensities, confirming the utility of time gating for signal discrimination; and (3) confirmation that Raman signal

duration aligned with gate widths, reinforcing the gating precision.

These results validate time-gated Raman spectroscopy as a robust method for fluorescence rejection and open new pathways for dynamic spectroscopic analysis of biological and complex material systems.

103 - IMPROVED ANTIFOULING CHARACTERISTICS OF MATERIAL SURFACES BY APPLYING NANOMATERIALS AND SURFACE MODIFICATIONS

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Microorganisms like fungi and bacteria pose significant challenges across various sectors, including food, agriculture, and healthcare. Contamination and cross-contamination of materials with bacteria substantially impact human health and contribute to economic strains. In 2011, the United States reported 9.4 million cases of foodborne illness and 721,800 cases of healthcare-associated infections. Since material surfaces and interfaces are the first points of contact with microorganisms, and considering the increasing number of outbreaks and incidents, researchers have focused on developing surface and coating strategies to hinder the attachment and growth of microorganisms.

The topography and chemical characteristics of a surface, including wettability, roughness, surface charge, and the presence of biocides or antimicrobial agents, impact the growth and adherence of microorganisms. Surface nano-roughness, in particular, is vital for creating superhydrophobic antifouling surfaces that effectively prevent microbial attachment and other types of fouling. Nanoparticles have attracted considerable attention over the last ten years because of their extremely small size and extensive surface area with unique properties. Applying nanoparticles to various surfaces and chemically modifying them offers an innovative approach to developing these antifouling surfaces. Compared to advanced methods like photolithography, nanoparticle deposition techniques, such as dip and spray coating, hold greater promise for sustainable solutions and large-scale manufacturing.

First, we explored how bacteria adhere to flat surfaces with various roughness levels and hydrophobic properties against *Salmonella*, *Listeria*, and *E.* coli. On superhydrophobic surfaces, bacterial adhesion was decreased due to (1) the interstitial air bubble's Laplace pressure force exceeding the bacterial adhesive force, (2) a reduced substrate area available for solid-liquid contact, and (3)the reduced attractive van der Waals force that helps bacteria adhere to the surfaces. Another key aspect of our research involves developing coatings using colloidal particles, nanoparticles, and surface modifications on various material surfaces and examining the performance of these coatings. Our goal is to reduce fouling and improve durability. We utilized various nanoparticles modified with perfluorinated and non-fluorinated chemicals. This resulted in superhydrophobicity on various material surfaces characterized by a water contact angle higher than 150° and a low sliding angle of less than 10°. The total reduction in bacterial adhesion ranges from 1.5 to 4-log CFU/mL, which enhances the antifouling surface properties derived from superhydrophobicity. Simultaneously, using sustainable release antimicrobial agents like lysozyme or essential oil, which are loaded into the nanoparticles on top of the material, resulted in a 4-6-log CFU/mL decrease in bacterial attachment. Spontaneously, the superhydrophobicity contributes to sufficient repelling efficiency against fungus, mud contamination, and dirt.

By utilizing the distinct characteristics of colloids and nanomaterials, along with their capacity to engage with different interfaces, we strive to develop innovative solutions for modern challenges and improve hygiene across various application areas.

104 - REGULATION OF INTERLEUKIN-8 (IL-8) GENE EXPRESSION BY BACTERIAL EXTRACELLULAR VESICLES ISOLATED FROM ORGANIC DUST IN THE HUMAN HMC3 MICROGLIAL CELL LINE

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Exposure to the agricultural environment is associated with the prevalence of neurological diseases such as Parkinson's and Alzheimer's diseases, and dementia. Dust particles are major constituents of agricultural bioaerosols, and their inhalation could increase brain inflammation and development of neurological diseases. Herein, we studied the effects of bacterial extracellular vesicles (EVs) isolated from industrial poultry farm dust on the regulation of interleukin (IL)-8 expression in the human HMC3 microglial cell line. Bacterial EVs are nanosized particles shed by gram-positive and gram-negative bacteria and carry proteins, lipids, nucleic acids and bacterial metabolites. IL-8 is a major chemokine for neutrophils, and microglial cells are resident macrophage type brain cells that play major roles in immune and inflammatory responses. IL-8 dysregulation has been implicated in several neurological disorders. We found that treatment with bacterial EVs induced IL-8 expression in HMC3 cells. Chemical inhibitor and siRNA knockdown studies demonstrated that toll-like receptor (TLR) 2 and TLR 4 and enhanced intracellular

reactive oxygen species (ROS) production by NADPH oxidases (NOX) mediate induction of IL-8 expression. Induction of IL-8 expression was found to be regulated at the transcriptional level via activation of NF-kB and STAT3 transcription factors. Our studies have shown that bacterial EVs are major inflammatory components of organic dust and have the potential to increase inflammation and cause cell/tissue damage in the brain.

105 - MACROPHAGE-MEDIATED BREAST CANCER LIVER METASTASIS THERAPY WITH LIPID NANOPARTICLES CARRYING siRNA FOR EphA2: IN VITRO AND IN VIVO STUDIES

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Breast cancer is the leading cause of cancer-related mortality in women, with distant metastasis being the primary reason. The liver is the third most frequent site of breast cancer distant metastasis. Unlike primary tumors and metastatic lesions in other organs, breast cancer liver metastasis (BCLM) growth relies heavily on the organ vasculature, leading to lesions that are hypovascularized. This prevents systemically administered agents from efficiently reaching the cancer cells in these lesions, causing transport-related resistance to therapy. Macrophages are the most abundant immune cell type in the cancer tumor microenvironment (TME), playing important roles in tissue remodeling, homeostasis, angiogenesis, progression, and response to therapy. These phagocytic cells remain in close proximity to BCLM and have been clinically utilized for imaging with nanomaterials. Transport barriers can be overcome using macrophages as carriers for nanotherapeutics, leading to efficient therapy for BCLM. siRNA therapeutics are nucleic acid-based macromolecules that hold promise for tumor therapy. Challenges related to siRNA delivery and clinical translation include poor stability and limited transport across biological barriers, which necessitate using nanoparticles as carriers. Ephrin type-A receptor 2 (EphA2) tyrosine kinase regulates important tumor-driving processes and is overexpressed in breast cancer. In the present study, we designed, characterized and evaluated the effect of siRNA EphA2 loaded lipid nanoparticles (siEphA2-LNP) in combination with albumin bound paclitaxel (nAb-PTX) on macrophage phenotype, transport and anti-cancer efficacy in *in vitro* and *in vivo* BCLM models. The siEphA2-LNP and nAb-PTX treated macrophages shifted the TME towards the pro-inflammatory, anti-tumorigenic milieu by polarizing the macrophages from the M2 to M1 phenotype. This resulted in increased apoptosis and decreased proliferation in MCF7 and MDA-MB-231 human breast cancer cells in treated groups as compared to controls. Studies in the 3D *in vitro* model that mimics clinically observed hypovascularized BCLM surrounded by macrophages, suggested that a balance between M1 and M2 macrophage phenotypes in the TME is required to optimize nanotherapeutic efficiency. *In vivo* studies in a syngeneic model of primary triple negative breast cancer and experimental BCLM showed decreased tumor volume when treated with siEphA2-LNP. Additionally, there was an increase in CD163 (M2 marker), F4/80 (pan-macrophage) and Ki67 (apoptosis) in the lesions. These findings were further utilized to computationally simulate BCLM therapeutic response to siEphA2-LNP and evaluate clinically relevant dosing strategies. Altogether, this study shows that EphA2 siRNA-loaded lipid nanoparticles can decrease BCLM tumor burden by modulating the tumor microenvironment.

106 - 3D PRINTING IN LEGAL PATHOPHYSIOLOGY: APPLICATIONS IN CRIMINAL, PERSONAL INJURY, AND MALPRACTICE CASES

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Medical imaging with 3D printing could become a powerful tool in courtroom pro-10 ceedings. This review explores the use of 3D-printed, patient-specific anatomical models 11 derived from imaging modalities like CT and MRI in legal cases, including criminal, 12 forensic, malpractice, and personal injury trials. These models provide a tangible, visu-13 ally impactful method to present evidence, offering advantages over traditional 2D 14 imaging by enhancing understanding for jurors and attorneys. Studies show that com-15 bining 3D models with verbal explanations significantly improves comprehension of 16 complex anatomical relationships. Creating these models involves converting DICOM 17 (Digital Imaging and Communications in Medicine) files into 3D-printable STL (Stand-18 ard Tessellation Language) files, followed by printing with methods like Fused Deposi-19 tion Modeling (FDM) or Stereolithography (SLA). Challenges include ensuring accuracy 20 and reliability, particularly in addressing imaging artifacts or complex anatomy. This 21 review highlights the critical roles of radiologists, forensic pathologists, surgeons, and 22 3D printing experts in maintaining model integrity and accuracy. We also examine legal 23 standards for admissibility of 3D-printed models as demonstrative evidence, empha-24 sizing their potential impact in malpractice and personal injury cases. Recommenda-25 tions include interdisciplinary collaboration and adherence to accuracy thresholds, such 26

as the ±2 mm dimensional accuracy standard suggested by Carew et al. (2019). By 27 bridging the gap between complex medical evidence and layperson understanding, 28 3D-printed models offer a transformative way to present evidence, improving clarity, 29 precision, and legal outcomes.

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108 - INTERFACIAL MOLECULAR STRUCTURE AT BIOMEMBRANE SURFACES

Saranya Pullanchery

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Understanding the interfacial structure of biomembrane surfaces is essential for elucidating mechanisms underlying membrane-mediated processes such as signaling, transport, and recognition. However, characterizing the molecular structure of interfaces is a challenging task. We implement vibrational sum-frequency generation (SFG) spectroscopy and second harmonic scattering (SHS) as powerful, complementary nonlinear optical techniques that enable molecular-level insights into the molecular organization at lipid membrane interfaces with intrinsic surface specificity and without the need for labeling. We demonstrate that the surface specificity of SFG spectroscopy can be used to identify the molecular details of specific ion effects at model membrane surfaces. The hydrogen bonding structure and dipolar ordering of interfacial water is probed using SFG to understand the distinct behavior of water at membrane interfaces. Extending the interface-specific measurements to spherical lipid droplets and liposomes using nonlinear scattering measurements reveals that hydration asymmetry exists across curved membrane systems and is highly dependent on the charge state of the membrane.

110 - CAN ERYTHROCYTE PERMEABILITY ALTER AIRWAY NITRIC OXIDE LEVELS?

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Blood flow in the lung increases in regions that are well oxygenated through incompletely understood mechanisms.[1] Furthermore, increased oxygen dramatically reduces the permeability of the red blood cell to nitric oxide (NO).[2] In the modeling of NO transport, red blood cells are generally considered to be a sink so that the concentration of NO in the blood side of the lung is zero. However, if the permeability of the red blood cell is small, the ability of the red blood cell to uptake NO is reduced, which will increase the concentration of NO in the blood. We propose a mechanism for the control of blood flow in the lung by which the reduced permeability of the red cell to NO increases NO concentration in the alveolus and therefore in the local bronchioles. The increased NO may diffuse back to the arterioles, which are intimately associated with the bronchiols, to relax them, and therefore provide the increased blood flow. This simple model examines the question as to whether the red blood cell permeability on the blood side, can affect the NO concentration on the airway side.

A one-dimensional model is used. NO is produced by the endothelium, modeled as infinitesimally thin at $x = 0$. Part of the NO flux passes into the capillary blood and the other part passes into the alveolus. The goal is to determine the ratio between those two parts and deduce whether scavenging of NO by the blood contributes significantly to the NO concentration in the alveolus. Convective-diffusion equations are used to model the two sides of the model separately, and then the boundary condition at the endothelium is used to match the concentrations of NO at the interface.

The result is an equation for the fraction of NO flux, into the capillary blood in terms of the average alveolar airflow, the diffusion coefficient in the blood, capillary diameter, and red cell membrane permeability multiplied by the red cell surface area per volume of blood. The fraction is calculated as a function of red cell membrane permeability, and it ranges from approximately 0.01 at a permeability of 0.04 cm/s to approximately 0.3 at a permeability of 90. The rate of change of with permeability is strongest for lower values of permeability, hence for higher oxygen levels.

Increased blood flow with oxygenation in the lung is opposite to the increased blood flow with hypoxia in the peripheral circulation. The mechanism proposed here can explain the effect in the lung without contradicting proposed mechanisms in the peripheral circulation. The analysis here is elementary, but it demonstrates the basic plausibility of the proposed mechanism. More precise modeling is required to find quantitative relationships among the blood gases and blood flow control.

111 - NOVEL MECHANISMS IN PLEURAL FIBROSIS: ROLE OF COAGULATION PROTEASE-INDUCED EXTRACELLULAR VESICLES

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Severe pleural space inflammation associated with exudative pleural effusions leads to the development of pleural fibrosis (PF), a debilitating condition marked by progressive remodeling of the pleural space. Despite its

clinical significance, the molecular mechanisms driving PF remain poorly understood, limiting therapeutic options. Key pathological features of PF include extravascular fibrin deposition, myofibroblast proliferation via mesothelial-to-mesenchymal transition (MesoMT) and fibroblast-to-myofibroblast transition (FMT), neo-matrix deposition, macrophage polarization toward a TGFβ-producing M2 phenotype, and neo-angiogenesis.

One of the earliest events in PF is the activation of the coagulation cascade due to tissue injury and inflammation. This leads to the expression of tissue factor (TF) on the mesothelium, which promotes the activation of factor X to Xa (FXa) and subsequent thrombin generation leading to extravascular fibrin deposition in the pleural space. Our prior studies have established that FXa and thrombin promote MesoMT in pleural mesothelial cells (PMCs), implicating them in the pathogenesis of PF. In our recent studies, we found that these proteases also stimulate the release of extracellular vesicles (EVs) from human PMCs (HPMCs). EVs are membrane-bound vesicles that mediate intercellular communication by transporting proteins, lipids, microRNAs (miRs) etc. They are implicated in various pathophysiological processes including inflammation, tissue repair, immune responses, cancer metastasis and lung injury. However, their role in the pathogenesis of PF remains unexplored. In our recent studies we found that FXa- and thrombin-induced EVs promote MesoMT in naïve HPMCs demonstrating profibrotic activity, promote endothelial tube formation in human umbilical vein endothelial cells (HUVECs), indicating proangiogenic potential, and stimulate TGFβ production in peripheral blood mononuclear cells, suggesting a role in macrophage polarization. These findings strongly suggest that EVs play a significant role in the pathogenesis of PF. Furthermore, we observed a marked increase in EV numbers in pleural lavages from preclinical mouse models of PF compared to saline-treated controls. Clinically, exudative pleural effusions from patients with empyema and parapneumonic effusions contained significantly higher levels of EVs than transudative effusions from patients with congestive heart failure. More importantly, the EVs isolated from the exudative effusions induced MesoMT in naïve HPMCs and promoted neo-angiogenesis *in vitro,* indicating their pathogenic potential.

Significance: Our study identifies EVs as previously unrecognized key contributors to the pathogenesis of PF, adding a new dimension to our understanding of this restrictive lung condition. Traditionally, the analysis of pleural effusions has focused on biochemical, cytological, and microbiological aspects. While these approaches provide valuable diagnostic information, many pleural effusions lack a clear etiology, complicating interpretation of the results. Integrating EV analysis alongside conventional techniques could potentially enhance diagnostic precision and facilitate development of tailored management strategies for patients with fibrosing pleural injury. Our ongoing research seeks to identify the specific cargo and signaling pathways regulated by EVs in PF and to translate these findings into clinically tractable therapies for the treatment of PF.

112 MICROBUBBLE-MEDIATED INTRACELLULAR PEPTIDE DELIVERY VIA BIOREDUCIBLE BONDS

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Background: Malignant tumors arise due to the abnormal mutation of a cell's genome. The resulting altered proteins generate novel peptide antigens which can be presented by the major histocompatibility complex (MHC) of antigen-presenting cells (APCs). The newly formed peptide/MHC complex can induce an adaptive immune response via $CD8^+$ and $CD4^+$ cytotoxic T lymphocyte (CTL) activation. This process is the cornerstone by which the immune system eradicates malignant cells. Immune checkpoint inhibitors (ICIs) work to remove the brakes on this process and are highly effective in tumors with high mutational burden. However, tumors with low mutational burden are often not responsive to ICI treatment. The goal of this project is to develop a cancer vaccine to "heat up" immunologically cold tumors with low mutational burden to sensitize them to immune checkpoint blockade.

To do this, tumor-specific antigens (TSAs) were conjugated to APC-targeted microbubbles (MBs) via a reducible disulfide linkage. When exposed to ultrasound, MBs oscillate and collapse to open transient pores in the membrane of the targeted cells to deliver their payload through a process termed sonoporation. Subsequently, disulfide bonds between peptides and phospholipids will be cleaved in the reducing environment of the cytosol to facilitate the release of antigens and promote their presentation by APCs.

We selected $OVA_{257-264}$ peptide (SIINFEKL) to validate our platform. It was synthesized with an added cysteine residue on the N-terminus for conjugation and then fluorescently labeled. Co-localization of fluorescent signal on the shell of the MB was observed by fluorescent microscopy suggesting successful conjugation of the peptides on the MBs' shell via disulfide linkages. Release of the fluorescently labeled peptide in response to 5 mM DTT (a reducing agent) was also validated quantitatively by flow cytometry. CSIINFEKL presentation on MHC-I was probed using

bone marrow-derived macrophages (BMDMs). Interestingly, more presentation was detected using CSIINFEKL than native OVA peptide. MBs were then formulated and conjugated with the APC-targeting antibody aCD11b and CSIINFEKL. Antigen presentation was increased by more than 5-fold using targeted MBs, suggesting that sonoporation is an efficient method to deliver peptide antigens to APCs. Antigen-specific T cell proliferation was measured by co-culturing CFSE-stained OT-I T cells with treated BMDMs 72h before evaluation by flow cytometry. OT-I cell proliferation was the highest using our platform and indicates strong potential for in vivo use.

This work provides the foundation to develop a platform for the delivery of neoantigens to APCs for personalized cancer vaccines. If successful, this platform will be combined with STING activators to both activate the STING pathway and enhance antigen cross-presentation to improve anticancer immune response. In vivo studies are in progress to determine efficacy against SB28-OVA, an OVA protein-expressing murine orthotopic glioblastoma model.

113 - EFFECTS OF FREQUENCY AND AMPLITUDE ON OSTEOBLAST-LIKE CELL VIABILITY AND METABOLISM UNDER VIBRATIONAL LOADING

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Mechanical stimuli play a critical role in regulating many cellular functions, such as proliferation, differentiation, migration, and signaling [1, 2]. While beneficial in contexts like bone remodeling and tissue healing, certain mechanical inputs may negatively impact cells, disrupting membrane integrity, inducing necrosis, and causing tissue damage [3]. Whole-body vibration (WBV), a well-documented occupational hazard across multiple professions, has been linked to injuries, musculoskeletal disorders, and chronic pain [4, 5]. Vibration bio-effects depend significantly on exposure parameters like frequency, amplitude, duration, and direction, with exposures near tissue natural (resonant) frequencies being particularly damaging [6, 7].

This study investigates how vibrational frequency and amplitude affect osteoblast-like SAOS-2 cells. Cells underwent a single 20-minute vertical vibration session under four different conditions: 90 Hz at 0.5g, 90 Hz at 1.5g, 10 Hz at 0.5g, and 10 Hz at 1.5g. These parameters were selected to simulate both therapeutic (low-magnitude high-frequency or LMHF) and potentially harmful (low-frequency near resonance, high-amplitude) scenarios. Previous studies indicated that 90 Hz vibrations enhance osteogenic activity, while 10 Hz approximates the natural resonance frequency of SAOS-2 cells and mimics WBV exposure scenarios [8, 9]. Additionally, amplitudes above 1g are associated with cellular stress or damage, so both sub-threshold (0.5g) and supra-threshold (1.5g) conditions were included [10]. Three control groups included non-vibrated cells maintained under normal culture conditions, a positive control supplemented with fetal bovine serum to promote cell viability and metabolic activity, and a negative control treated with prolonged Accutase exposure to induce membrane damage. These controls ensured the ability to distinguish between baseline, enhanced, and compromised cellular states.

Following vibration, cells were harvested and assessed using Trypan Blue exclusion via an automated cell counter for viability, and an XTT assay to evaluate metabolic activity. Similar initial cell densities were maintained to ensure reliable comparisons. These complementary approaches enabled evaluation of both membrane integrity and functional metabolic response. As hypothesized, the condition with the greatest resonance (10 Hz at 1.5g) yields the most significant cell death and metabolic suppression due to amplified vibrational energy. Mixed conditions (90 Hz at 1.5g or 10 Hz at 0.5g) produce intermediate levels of damage, while the LMHF condition (90 Hz at 0.5g) results in the lowest cell death and an increase in metabolic activity, aligning with prior studies on beneficial vibration regimes. The negative control confirms assay sensitivity, showing substantial reductions in both viability and metabolic activity.

This study contributes to a foundational understanding of cellular responses to mechanical vibration with varying frequencies and amplitudes and supports the development of protective guidelines for occupational exposure and safe vibration-based therapies. Additionally, findings inform future computational modeling of cell membrane mechanics under vibrational loading, laying the groundwork for predictive simulations of cellular damage.

114 - ACCURATE AND EFFICIENT CHEMICAL SIMILARITY SEARCH TOOL AND CONTACT DISTRIBUTION-MATCHING METHOD JOINTLY IDENTIFY FDA-APPROVED DRUGS THAT MODULATE SARS-CoV2 -1PRF AND SUPPRESS ITS REPLICATION

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Unlike constantly mutating capsid proteins, the -1 programmed ribosomal frameshifting (-1PRF) mechanism and the mRNA pseudoknot (PK) that triggers PRF are conserved in coronaviruses. This makes -1PRF an attractive target for antiviral strategies. However, the molecular mechanism of frameshifting induction and targetable PK regions remain unclear. In this study, we integrate molecular docking, molecular dynamics (MD) simulations, and a dual luciferase assay (DLA) to identify small molecules that modulate frameshifting efficiency (Feff) in SARS-CoV2. We also developed SmChem, a chemical similarity search engine to repurpose FDA-approved drugs as Feff modulators. To enhance screening, we introduced contact-distribution-matching method. By comparing the drug-PK contact profiles of known Feff modulators to those of over 2000 FDA-approved drugs, we significantly narrowed candidate selection. Several novel Feff modulators were validated biochemically via DLA and shown to suppress viral replication. With further testing of the mechanical stability of PK in the presence/absence of identified Feff modulators using optical tweezers and Steered MD, we provided new insights into PK conformational dynamics and their role in -1PRF efficiency. Our platform presents a powerful strategy for rational RNA-targeted drug design using repurposed compounds.

115 - A DYNAMICAL LATENT VARIABLE MODEL OF HUMAN BEHAVIOR IN COMPETITIVE INTERACTION

Kensuke Arai[1], Ali Yousefi[2], Amer Ziouziou[3], Pedram Rajaei[3], Christinejulie Eyanuku[4]

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In our recent work [Arai et al., Scientific Reports, 2025], we showed that behavioral patterns in human choice during repeated Rock-Paper-Scissors (RPS) games against an exploiting AI reveal individual variations in behavioral traits across domains such as social engagement, imagination, and routine behavior—dimensions that were traditionally assesed through self-report questionnaires like the Autism Spectrum Quotient. Players can avoid exploitation by playing equiprobable, random hand choices (Nash Mixed Equilibrium), but we found human subjects instead switch periodically within a repertoire of nearly probabilistic rules for the next hand, possibly to mimic randomness. Expanding on these findings, we introduce a dynamical latent variable model that enables principled inference of internal behavioral states from raw gameplay data. This model captures the timing and structure of rule switches, revealing the latent rule-switching dynamics underlying game play. We aim to identify interpretable markers of individual traits from behavioral features derived from the rule-repertoire, potentially offering a new window into understanding decision-making and social cognition through interactive behavior.

116 - A DYNAMICAL LATENT VARIABLE MODEL OF HUMAN BEHAVIOR IN COMPETITIVE INTERACTION

Ken Arai[1], Ali Yousefi[2], Amer Ziouziou[3], Pedram Rajaei[3], Christinejulie Eyanuku[4]

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117 - DEVELOPMENT OF A NOVEL MICROBUBBLE BASED PLATFORM FOR TARGETED INHIBITION OF GENES

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Small interfering RNA (siRNA) mediated gene silencing as a form of gene therapy faces drug development issues due to the easily degradable nature and overall negative charge of siRNA[1]. Our objective is to use targeted microbubbles (MBs) to deliver siRNA into cancer cells to silence genes with spatiotemporal control through the development of a

novel platform called "Microbubble-assisted Ultrasound-guided Targeted INhibition of Genes" (MUTING).

Microbubbles were initially formulated with phospholipid shells and perfluorobutane (PFB) core. Cationic spermine-modified dextran (SpeDex) and targeting antibodies were conjugated onto the MB shells which was confirmed with flow cytometry. siRNA was loaded onto SpeDex with electrostatic binding to form nanocomplex loaded MBs (ncMBs). Zeta potential and SYBR Gold nucleic acid gel stain confirmed successful siRNA loading onto MBs.

To explore the potential of our platform to successfully deliver siRNA under ultrasound (US) guidance, $EpCAM^+$ 4T1 cells were incubated with ncMBs for 10 min and then insonated for 1 min using a 1 MHz transducer with 2 W/cm^2 power density, and 50% duty cycle. To assess MUTING's efficacy *in vivo*, 4T1 triple-negative breast cancer (TNBC) model was established in Balb/cJ mice. Tumors were injected intratumorally with controls or ncMBs once they reached ~100 mm^3. For insonation groups, US was applied for 2 minutes at 4 W/cm^2, 50% duty cycle. Tumors were collected 24 hours after treatment for Western blot analysis to assess gene silencing.

MUTING performed better than Lipofectamine transfection against DNA mismatch repair gene *MLH1* in vitro and achieved complete silencing in vivo. Additionally, MUTING-mediated silencing of oncogene c-myc in 4T1 cells was quantified by qRT-PCR. Currently, we are exploring MUTING's potential to target undruggable oncogenes, with the aim of combining it with other therapies for synergistic treatment of cancer.

118 - EVALUATING QUALITY CONTROL METRICS IN MICROPARTICLE FORMULATION FOR SUSTAINED DRUG RELEASE

Atharva Markale

New Jersey Institute of Technology

Poly(lactic-co-glycolic acid) PLGA microparticles are the most versatile platform for gene therapy, immunotherapy and drug delivery because of their biocompatibility, biodegradability and encapsulation efficiency. However, reproducibility remains challenging in fabricating polymeric drug delivery systems, particularly when transitioning formulations from bench-scale development to clinical translation. Here, we analyzed the impact of synthesis parameters, which causes variation in quality control (QC) and the performance of single and double emulsion microparticles encapsulated with rapamycin and rhCCL22. These immunomodulatory agents were loaded using water-in-oil (W/O) and water-in-oil-in-water (W/O/W) emulsion-solvent evaporation methods widely used for encapsulating hydrophobic and hydrophilic compounds, respectively.

Microparticles were prepared using PLGA as the matrix polymer dissolved in dichloromethane (DCM). For rapamycin-loaded MPs, a single emulsion (W/O) was created by dissolving rapamycin in DMSO and mixing it into the PLGA-DCM phase, followed by homogenization into an aqueous polyvinyl alcohol (PVA) solution. For CCL22-loaded MPs, the hydrophilic protein was dissolved in an aqueous phase containing salt and albumin, which was then sonicated into the organic PLGA phase to form a primary W/O emulsion. It was further emulsified into a secondary PVA aqueous phase via homogenization to generate a stable W/O/W emulsion. The emulsions were subjected to solvent evaporation and washing to remove residual surfactant and solvent. The microparticles were flash-frozen and lyophilized to yield dry, free-flowing powders.

This synthesis process was repeated across multiple experiments with drug-loaded and blank formulations to look at interday and intra-batch variations and user variation. Scanning electron microscopy (SEM) analyzed particle morphology and surface topography. Particle size distribution was measured using a coulter counter, and the pore distribution pattern was analyzed using custom code. Drug loading efficiency was quantified, and in vitro drug release studies were conducted under standardized conditions.

Our analysis revealed noticeable variations in particle size, encapsulation efficiency, and surface characteristics across batches produced on different days and by different users. Drug release profiles showed significant variability, particularly during the initial burst and mid-phase release. These findings demonstrate that minor inconsistencies in emulsification energy, solvent removal, or user technique can lead to measurable differences in particle performance and drug delivery behavior. However, the pore distribution pattern remained consistent despite variations with some changes in pore size for users.

By systematically quantifying intra-day, inter-day, and user-driven variability, this work offers a framework for quality control and standardization in microparticle fabrication. While formulation and release optimization are widely reported, the influence of human and temporal process variation remains under-addressed. Our findings suggest the need for standardized quality control checkpoints, including morphological analysis, pore density and pore size analysis, size profiling, and release rate comparisons, to assess batch reliability. The outcomes of this work highlight the impact of emulsification speed, surfactant concentration, and solvent evaporation time on final

particle morphology, yield, and encapsulation behavior. By comparing two fabrication strategies for microparticles using consistent protocols and equipment, we try to highlight how process-dependent factors influence particle characteristics, particularly with small molecules and proteins. This study contributes to process optimization and quality control measures essential for scaling up formalization and critical for regulatory approval and clinical application.

119 - NEUROPROTECTIVE EFFICACY OF MINOCYCLINE THERAPY IN EXPERIMENTAL MODERATE TRAUMATIC BRAIN INJURY

Geetika Sruti Vutukuri Amarnath[1], Ritika Roy[1], Pragya Dhungel[1], Yashwanthi Yanamadala[1], Afrika Williams[1], Claire Jones[1], Xiao-Hong Lu[2], Teresa Murray[1]

[1]Louisiana Tech University, Lafayette, LA [2]Louisiana State University Health Sciences Center-Shreveport, Shreveport, LA

Traumatic brain injury (TBI) remains as a major contributor of mortality and long-term neurological dysfunction, with approximately 22% resulting in patient deaths and 30% suffering impaired brain function. Especially, moderate TBI, which has similar neurological deficits as other neurodegenerative diseases, make it difficult to be diagnosed early on and limits timely therapeutic interventions. According to the CDC in 2010, direct and indirect costs of approximately $76.5 billion goes for TBI treatment making it costly and causing societal and economic burdens on patients and their families. We currently have treatments that target symptoms such as depression; however, there are no approved therapies that mitigate the secondary injury cascade which leads to inflammation, neuronal apoptosis, axonal cytoskeleton damage, and excitotoxicity. We hypothesize that administration of minocycline (Min), a second-generation tetracycline antibiotic, may suppress secondary injury mechanisms post-TBI. Therefore, three treatment groups, consisting of 19 mice/group are considered. These are positive (TBI-vehicle) and negative (Sham-vehicle) control groups and one experimental group: mice treated with Min alone. Behavioral studies with the rotarod test showed significant improvement in motor coordination in the Min treatment group compared to TBI-vehicle controls at both 7- and 14-days post-injury and were comparable to sham controls. Immunohistochemistry-based tissue analysis of microglial (Iba-1) morphological characteristics and astrocyte response was performed. Results showed that Min significantly reduced inflammation when compared with untreated, injured mice, suggesting the drug's potential to mitigate secondary neurodegeneration following moderate TBI further establishing the therapeutic potential of minocycline. Ongoing studies are focused on further analyzing glutamate increase post-TBI (moderate) and its long-term outcomes.

120 - ICAM-1-TARGETED ANTIBODY-NANOCARRIER SYSTEM FOR SELECTIVE DELIVERY TO ISCHEMIC MUSCLES: A BIODISTRIBUTION STUDY IN PAD

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University of Texas at Arlington, Arlington, TX

Introduction: Peripheral arterial disease (PAD) is a chronic and progressive vascular condition that primarily affects elderly and diabetic populations. Despite available treatments such as stents, bypass surgery, and gene or stem cell therapies, these interventions often yield limited success due to poor targeting and restricted delivery to ischemic tissues. While conventional nanoparticles offer potential for drug and gene delivery, non-targeted systems frequently suffer from poor tissue specificity and off-target distribution, especially in poorly perfused ischemic environments. To address these limitations, we developed an actively targeted nanocarrier system using poly(lactic-co-glycolic acid) (PLGA) nanoparticles conjugated with anti-intercellular adhesion molecule-1 (αICAM-1) antibodies. This antibody-functionalization enables selective binding to ICAM-1, a molecule significantly upregulated in inflamed and ischemic vasculature, thereby enhancing localization, retention, and therapeutic payload delivery to diseased tissues in PAD.

Methods: Antibody-conjugated PLGA nanoparticles were designed to actively target ICAM-1, a molecule overexpressed in ischemic tissues. PLGA nanoparticles were synthesized using a double emulsion solvent evaporation method and covalently conjugated with αICAM-1 antibodies via NHS/EDC chemistry. Nanoparticles were characterized for size, zeta potential, morphology, and antibody conjugation efficiency. In vitro binding assays with TNF-α-stimulated endothelial cells confirmed ICAM-1-mediated targeting. Preliminary biodistribution studies demonstrated that αICAM-1-conjugated nanoparticles showed significantly enhanced accumulation in ischemic muscles compared to non-targeted controls. Building on these promising results, we are now conducting an expanded in vivo biodistribution study with a larger animal cohort to validate targeting efficiency and assess consistency across time points. Nanoparticles were characterized for physicochemical properties and antibody conjugation efficiency. Targeting specificity was confirmed in vitro using TNF-α-activated endothelial cells. For in vivo analysis, IR-820-loaded αICAM-1 nanoparticles were intravenously administered

into a murine PAD model, and tissue accumulation was assessed through in vivo and ex vivo imaging as well as immunohistochemistry of tissue sections.

Results: Antibody-conjugated PLGA nanoparticles exhibited a uniform size distribution (~150-200 nm) and appropriate surface charge for systemic delivery. Successful antibody functionalization was confirmed through conjugation efficiency analysis. In vitro binding assays demonstrated that αICAM-1-conjugated nanoparticles showed significantly higher binding to TNF-α-activated endothelial cells compared to non-targeted controls, confirming the role of ICAM-1 in mediating targeted interactions. In vivo biodistribution studies further supported these findings: IR-820-labeled αICAM-1 nanoparticles preferentially accumulated in ischemic muscle tissues of PAD mice, with signal intensity correlating strongly with regions of elevated ICAM-1 expression confirmed via immunohistochemistry. Fluorescence signals in ischemic limbs remained consistently elevated at 4, 24, and 72 hours post-injection, indicating sustained tissue retention and enhanced targeting. These results validate the targeting strategy and support the potential of antibody-conjugated nanocarriers for selective delivery in PAD.

Conclusion: This study demonstrates that αICAM-1 antibody-conjugated PLGA nanoparticles can selectively accumulate in ischemic tissues due to ICAM-1 overexpression, validating their potential for targeted delivery in PAD. Our biodistribution data supports the feasibility of antibody-functionalized nanocarriers for future therapeutic applications, and ongoing work will assess therapeutic payload delivery and long-term efficacy [funding support of this research: the American Heart Association Institutional Research Enhancement Award 25AIREA1357216 (TN)].

122 - FUTURE OF NANOMEDICINE: MICROROBOTS, AI, AND NANOPORES FOR PRECISION DIAGNOSTICS AND THERAPY

Minjun Kim

Southern Methodist University, Dallas, TX

The intersection of nanotechnology, artificial intelligence (AI), and microrobotics is revolutionizing the field of medicine, enabling unprecedented capabilities in targeted drug delivery, minimally invasive surgery, and single-molecule diagnostics. This seminar will explore the latest advancements in bioinspired microrobots, AI-driven localization and control systems, and nanopore-based biosensing, all of which are shaping the future of nanomedicine. We will discuss the development of microrobots that leverage biological and synthetic actuation for precise navigation in complex microenvironments, enabling efficient drug transport and localized therapeutic interventions. Additionally, AI-powered control and non-vision-based localization techniques are enhancing real-time microrobotic manipulation, addressing challenges such as low signal-to-noise ratios and external disturbances. Another key focus will be nanopore technology, which has emerged as a powerful tool for single-molecule sensing, enabling the detection of biomolecules, antigens, and protein interactions with high sensitivity. Applications in viral diagnostics, gene therapy, and soft nanoparticle characterization will be highlighted, demonstrating how nanopores are transforming personalized medicine and early disease detection. By integrating microrobotics, AI, and nanopores, the future of nanomedicine holds immense potential for precision diagnostics and therapy, offering novel solutions to some of the most pressing challenges in healthcare. This seminar will provide insights into the latest research, experimental breakthroughs, and future directions in this rapidly evolving field.

123 - USING STEREO-EEG TO CHARACTERIZE MUSICOGENIC NEURAL ENTRAINMENT IN HUMANS

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It is widely recognized that music can have profound effects on electrophysiological brain signaling, potentially leading to therapeutic benefits. However, the mechanisms underlying this neuronal entrainment remain poorly understood. Although multiple EEG and functional MRI studies have explored this phenomenon, limited access to signaling from deeper subcortical structures has hindered a more comprehensive understanding. In this study, we utilize stereoelectroencephalography (SEEG) to examine brain activity in regions such as the temporal lobe, hippocampus, amygdala, and orbitofrontal cortex. SEEG, the current gold standard for seizure localization in patients with epilepsy, offers the temporal resolution of surface EEG along with high spatial resolution for capturing activity in subcortical structures. Music engages a broad network of brain regions, from auditory processing areas in the temporal lobe to emotion- and memory-related structures like the hippocampus and amygdala. To probe this network, we have designed an auditory stimulus with three conditions: Music alone (M), Vocals alone (V), and Music with Vocals (MV). Patients will be visited on post-operative days 2, 3, and 4 for stimulus presentation and data collection. Following exposure, SEEG data will be analyzed to

examine how different brain regions respond and interact across stimulus types. We hypothesize that the spectral topography of the auditory cortex will vary with the nature of the audio stimuli. In particular, vocal cues are expected to activate speech-processing regions and associated higher-order networks. We aim to map functional connectivity using wave-power synchronization and assess how factors such as post-operative recovery and medication regimens influence neural responses. The data generated from this study will be critical for localizing and characterizing human brain responses to auditory stimuli and may inform the development of targeted music-based therapeutic interventions.

124 - DECREASING HEART INFLAMMATION IN A DIABETIC MOUSE MODEL WITH *Hippocraeta Velutina* EXTRACT

Maricica Pacurari

Jackson State University, Jackson, MS

Introduction. Streptozotocin (STZ)-induced diabetic mouse model is a widely used model to study cardiomyopathy in diabetes. In the present study, we investigated whether *Hippocraeta Velutina* (HV) plant methanol extract will ameliorate heart inflammation in STZ-diabetic female mice. **Materials and Methods.** CBL57 female mice 10 wks old were intraperitoneally injected with citrate buffer (control, n=5) or 75 mg/ml streptozotocin for 7 consecutive days after which the mice were provided ad libitum food and water. After 9 days, fasting blood glucose was measured and diabetic mice (200 mg/ml glucose) were assigned to STZ (n=5) and STZ+HV (n=5). HV was commercially acquired and the leaves were air-dried, pulverized, and the leaves extracts were obtained after maceration in 80% methanol. The mixture was filtered, evaporated, lyophilized and reconstituted in distilled water before administering it to mice. HV extract was orally garaged. After two weeks, the heart and blood were collected and used for further analysis. **Results.** H&E analysis of heart from day 0 (pre-diabetes) to day 14 (diabetes) and day 28 when the animals were sacrificed showed profound morphological changes of the heart structure of the diabetic mice. However, in the STZ+ HVE group, heart morphology appeared slightly improved with lesser infiltration of inflammatory cells. Analysis of inflammatory gene TNFalpha in the heart was significantly increased in the diabetic mice whereas in the HVE treated group TNFalpha decreased. In conclusion, the present preliminary data indicate that HVE alleviates diabetes-induced cardiac inflammation and warrants further investigation.

125 - ADVANCEMENT TOWARDS A CLINICAL DECISION TOOL: UTILITY OF ULTRASONOGRAPHY TO MONITOR AND QUANTIFY CLOT SIZE IN A RABBIT MODEL OF RETAINED HEMOTHORAX

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Background: Hemothorax (HTX) is the accumulation of blood in the pleural space, which can result from blunt trauma (e.g., motor vehicle collisions), penetrating injuries (e.g., gunshot wounds), coagulopathic conditions (e.g., hemophilia, malignancies), iatrogenic causes (e.g., thoracotomy), or medications that impair clotting (e.g., anticoagulants, thrombolytics). When intrapleural blood clots and fails to drain, it progresses to a retained hemothorax. Management of RH typically requires surgical evacuation or intrapleural fibrinolytic therapy (IPFT). Early detection and continuous monitoring of retained hemothorax is critical in guiding appropriate treatment decisions. In the United States, chest radiography and computed tomography are commonly employed to detect hemothorax and retained hemothorax. However, repeated imaging using these modalities exposes patients to cumulative ionizing radiation. Comparatively, ultrasonography offers a safer, more cost-effective, and portable alternative, particularly advantageous in rural or resource-limited hospital settings. In this study, we developed an ultrasound-based assessment tool to detect retained hemothorax formation and evaluate treatment efficacy in a rabbit model of retained hemothorax. **Methods:** This assessment tool was developed as a proof of concept based on previous use of ultrasonography to monitor the accumulation of pleural effusion in a rabbit model of empyema. In this study, a rabbit model of retained hemothorax was induced and monitored over a 7-day period. Retained hemothorax was treated with IPFT to promote clot dissolution, pleural fluid drainage, and lung re-expansion. Ultrasonographic imaging (Logiq e, R10 v1.3, GE Healthcare) was employed to evaluate retained hemothorax progression from induction to endpoint. The built-in distance measurement tool was used to calculate the two-dimensional (2D) clot area (cm^2) before (0h) and after treatment (24h) with either vehicle or IPFT. To validate the accuracy of our ultrasonographic measurements, 2D clot areas were compared and correlated with gross clot volumes (ml) determined via clot displacement (Δ volume). This comparison and gross examination served to assess the reliability of ultrasound for detecting and quantifying retained hemothorax. **Results**: Using ultrasonography, we were able to successfully detect the following outcomes: presence of clot, changes in clot size, and pleural effusion

formation: demonstrating that our model can replicate clinical retained hemothorax. Moreover, the assessment tool was able to differentiate the clot size and dissolution between rabbits treated with either vehicle or IPFT ($p < 0.001$), providing evidence that treatment efficacy can be determined and measured in vivo. Lastly, 2D clot measurements correlated with gross clot volume, thereby validating this method of retained hemothorax detection ($p < 0.0001$). **Conclusion:** Ultrasonography enabled the detection and quantification of retained hemothorax in our rabbit model, offering reliable, non-ionizing, and repeatable clot measurements. These findings support the further use of this method in preclinical research and its potential application to guide clinical practice.

126 - ENHANCED NEUROCHEMICAL DETECTION USING MXENE/PEDOT-COATED FLEXIBLE GLASSY CARBON MICROELECTRODE ARRAYS

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Abstract. The development of flexible neural interfaces with high sensitivity and stability is essential for advancing neurochemical sensing technologies. Glassy carbon (GC) microelectrode arrays (MEAs) are promising candidates due to their electrochemical stability and mechanical compliance with neural tissue. In this study, we enhance the electrochemical performance of flexible GC MEAs through a composite coating of $Ti_3C_2T_x$ MXene and poly(3,4-ethylenedioxythiophene) (PEDOT). This MXene/PEDOT layer combines the high electrical conductivity, large surface area, and redox-active surface chemistry of MXene with the excellent charge transport properties of PEDOT. An optimized electrochemical deposition protocol was developed to ensure uniform coating and strong adhesion on the GC microelectrodes. Scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) confirmed the homogeneous distribution of MXene within the composite layer. Electrochemical characterization using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) revealed a tenfold increase in charge transfer capacity and a corresponding reduction in impedance across the 1 Hz to 10 kHz frequency range. Square wave voltammetry (SWV) demonstrated high sensitivity and well-resolved peaks for dopamine (DA) and serotonin (5-HT) detection. Preliminary in *vivo* experiments in mouse brains confirmed the reliable performance of the modified electrodes under physiological conditions. These results demonstrate the strong potential of MXene/PEDOT-coated GC MEAs as high-performance platforms for real-time neurochemical monitoring.

127 - MXene/MOF COMPOSITE ELECTROCHEMICAL SENSOR FOR DOPAMINE DETECTION

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Two-dimensional (2D) titanium carbide nanosheets (MXene) have a unique ceramic-metallic hybrid nature and oxygenated terminations to offer excellent conductivity, hydrophilic surface, flexibility, and thermal stability. To enable its potential in sensing applications, we synthesized a composite with metal-organic framework (MOF) crystals intercalated between the nanosheets of MXene. Such 2D-0D architecture not only helps prevent the self-restacking issue in 2D nanosheets but also provides a large surface area, numerous adsorption and electrochemical sensing sites, and spacious mass transfer pathways for probe diffusion, all critical for superior sensing materials. The MXene/MOF hybrid material was characterized by XRD, SEM, HR-TEM, XPS, and EDS to reveal its crystal structure, surface morphology, composition, and electronic states. It was further made into modified glassy carbon electrodes (GCE) and tested for their electrochemical properties by cyclic voltammetry (CV) under different scan rates and pH values. It was found that MXene/MOF modified GCE showed excellent electroconductivity and catalytic activity. When detecting dopamine via differential pulse voltammetry (DPV), it exhibits a detection limit of 0.3 nM with a sensing range of 0.01-50 μM. Well-separated DPV peaks were observed when sensing dopamine without and with excess uric acid, ascorbic acid, and glucose, common interfering bioactive compounds. With the recovery rate of 97.5%, our MXene/MOF modified electrode exhibited good sensitivity, selectivity, and reproducibility as an electrochemical sensor for the detection of dopamine molecules.

128 - DISCRETE BRUSH POLYMERS ENHANCe 19F MRI PERFORMANCE THROUGH ARCHITECTURAL PRECISION

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The development of metal-free magnetic resonance imaging (MRI) agents demands precise control over molecular architecture to achieve optimal performance. Current fluorine-based contrast agents rely on maximizing fluorine content (>20 wt %) for sensitivity, requiring extensive solubilizing groups that lead to signal-

diminishing aggregation. Here we show that discrete brush polymers ($Đ$ = 1.0) with precise backbone lengths and a single terminal fluorine group achieve superior imaging performance through architectural control rather than high fluorine content. This design prevents both intra- and intermolecular fluorine aggregation while maintaining high aqueous solubility, enabling sharper signals and higher sensitivity than conventional systems despite containing less than 7 wt % fluorine. Systematic investigation reveals how backbone length controls fluorine mobility and signal generation, establishing clear structure-property relationships previously obscured by molecular heterogeneity. This work demonstrates how precise architectural control can enhance functional performance beyond traditional approaches, providing new strategies for designing imaging materials.

129 - POLYMERIC THIOPHENE FOR DETECTING MILD TRAUMATIC BRAIN INJURY-SPECIFIC microRNAs

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Gene activation and suppression in the human body are regulated by microRNAs (miRNAs) that are short single-stranded RNA molecules. Specific miRNAs have been shown to be upregulated in many diseases such as rheumatoid arthritis and Alzheimer disease as well as neurological conditions such as mild traumatic brain injury (mTBI). The non-specific nature of mTBI symptoms poses challenges for accurate diagnosis at point-of-care, leading to undetected cases and potential long-term consequences. Point-of-care refers to diagnostic testing at the place and time where the patient receives medical care. The key challenge for miRNA detection at point-of-care is the low abundance of miRNA in biological samples which requires high sensitivity and specificity of the detection platform. To address these issues, we developed a novel electrochemical platform for detecting upregulated mTBI-specific miRNAs in salivary samples of mTBI patients. Key design of our platform is the use of polymeric thiophene having carboxyl groups. The interaction between the thiophene sulfur and gold ensures immobilization to the electrode surface and the carboxyl handle allows for functionalization of the polymer with streptavidin. Anti-miRNAs having biotin for binding to the streptavidin-decorated polymeric thiophene and methylene blue as the electrochemical reporter were successfully immobilized on the gold electrode. This system successfully detected electrochemically picomolar concentrations of mTBI-specific miRNAs in saliva samples.

130 - FIBRINOLYTIC ACTIVITY ASSAY, FPA96F, FOR RAPID IN VITRO AND EX VIVO EVALUATION OF LINEAR PEPTIDES PROTECTING FIBRINOLYSINS FROM PLASMINOGEN ACTIVATOR INHIBITOr (PAI-1).

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Background: Empyema is an infectious disease characterized by a buildup of pus in the pleural cavity and combined with fibrin deposition restricts a patient's ability to breathe. Currently this disease is treated by drainage with a chest tube (with or without enzymatic therapy;ET) or surgery. Enzymes, urokinase(uPA) and tissue-type(tPA) plasminogen activators are used clinically to promote fibrin dissolution and drainage. Plasminogen Activator Inhibitor(PAI-1), which is overexpressed in empyema and inactivates enzymes with stoichiometry of inhibition (SI, the number of PAI-1 molecules needed to inhibit one molecule of enzyme) close to unity. Monoclonal antibodies(mAbs) increase the SI by more than two orders of magnitude and mAbs' based PAI-1-Targeted Fibrinolytic Therapy(PAI-1-TFT) resulted in up to a 8-fold increase in the efficacy of ET in the validated rabbit model of empyema[1,2]. A set of GLP-friendly peptides, competing with mAbs was selected from a phage display library in order to decrease size and cost of the adjunct. We hypothesized that our FPA96F assay allows rapid *in vitro* and *ex vivo* evaluation of individual peptides and their combinations in order to move them towards testing in the animal model. **Methods:** Four peptides(#1-4) were evaluated for their ability to protect fibrinolysis from up to 64-fold molar excess of PAI-1. The FPA96F 96-well plate assay was used to measure fibrinolytic activity generated by 5 nM of tPA or uPA after 5 min incubation with PAI-1 or PAI-1/Vn (0-320 nM) with or without the presence of peptide(0.1 mM) and/or a FITC-fibrin film(0.02 mg) in 0.05 ml of a buffer solution. The fibrinolytic activity was measured from an increase in the FITC fluorescence (excitation 490 nm, emission 512 nm) with time after adding 0.05 ml of either human Glu-plasminogen (200 nM) or pleural fluid (1:10) collected from the rabbit model of empyema. PAI-1 neutralization was assessed as an increase in SI when compared to the control (no peptide(s) present). **Results:** FPA96F assay demonstrates high reproducibility and allows fast evaluation of PAI-1 neutralizing adjuncts (such as mAbs, nanobodies, peptides and low molecular weight compounds) *in vitro* and *ex vivo* under different conditions. Novel GLP-friendly peptides induced an increase in the SI (1.3-28.6) *in vitro* and *ex vivo*, which was comparable to that for anti-PAI-1 mAbs. While peptides are

more effective in protection of fibrinolysis induced by tPA than uPA, peptide #2 was highly effective *in vitro* for both enzymes (>90 and >80% of PAI-1 neutralization, respectively). While vitronectin partially protects PAI-1 from neutralization with peptides #1-4, more than 70% of PAI-1 activity was inhibited *in vitro*. Moreover, *ex vivo* experiments demonstrated excellent protection of tPA by peptides 1, 2 and 3 (>90, >80 and >80% of PAI-1 neutralized, respectively). **Conclusions:** The consistency of the results across multiple experiments supports the hypothesis that the FPA96F allows rapid testing of novel treatments for empyema and, potentially, other fibrotic disorders. Further studies are needed to reveal the molecular mechanisms by which peptides neutralize PAI-1. Peptides #1 and #2 are the lead candidates for further preclinical evaluation in our validated rabbit model of empyema.

131 - MATERNAL POLY (I:C) EXPOSURE DISRUPTS CEREBRAL CORTICAL AND HIPPOCAMPAL NEUROGENESIS IN THE OFFSPRING MICE

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Neurodevelopmental disorders (NDDs) are a group of mental and cognitive conditions that arise from disruptions in early brain development, affecting approximately 15% of children under the age of 17. NDDs are highly heterogeneous in their etiology, neuropathology, and clinical manifestations. Among various genetic and environmental risk factors, maternal infection during pregnancy has been consistently associated with an increased risk of major NDDs, including Autism Spectrum Disorder (ASD), Attention-Deficit/Hyperactivity Disorder (ADHD), schizophrenia, cerebral palsy, and bipolar disorder.

Maternal immune activation (MIA)—induced in animal models by polyinosinic: polycytidylic acid [poly (I:C)], a synthetic analog of double-stranded viral RNA—has been shown to elicit behavioral phenotypes resembling ASD and schizophrenia. However, the cellular and molecular mechanisms underlying these effects remain poorly understood.

In this study, we investigated immune responses in the placenta and neurogenesis in the cerebral cortex and hippocampus of offspring following MIA in mice. Pregnant mice were administered poly (I:C) at gestational day 12.5. After 72 hours, cytokine profiles and immune cell infiltration in the placenta were assessed. On postnatal day 6, markers of neural progenitors and immature neurons were examined using immunofluorescence and Western blotting.

Our data revealed that 16 cytokines in the placenta and 35 in the amniotic fluid were significantly elevated following MIA. We also observed macrophage and neutrophil infiltration in the placental labyrinth and robust microglial activation in the offspring's brain. MIA disrupted neurogenesis in both the cortex and hippocampus, evidenced by a reduction in early-born $Tbr1^+$ neurons in the cortex and Dcx^+ immature neurons in the subventricular zone, alongside an increase in $Ctip2^+$ neurons in the hippocampus.

In conclusion, our findings demonstrate that MIA induces placental and fetal brain immune activation and perturbs neuronal developmental programs in key brain regions involved in cognition and social behavior, offering mechanistic insight into how maternal infections may contribute to NDDs.

132 - PRESSURE ANALYSIS OF PATIENT SPECIFIC AORTIC PHANTOMS IN A CUSTOM MOCK CIRCULATORY LOOP

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Aortic stenosis (AS) is one of the most prevalent valvular diseases in developed societies. Transcatheter aortic valve replacement (TAVR) is commonly used to treat severe AS. Blood clot (thrombus) formation on implanted valves is a known adverse event following TAVR [1]. Thrombosis is typically managed with anticoagulants, which carry a risk of excessive bleeding [2][3]. Gaining insight into an individual patient's risk of developing thrombosis could help physicians tailor anticoagulant dosing regimens to minimize side effects.

Anatomical and hemodynamic factors can be used to predict the risk of thrombus formation after TAVR [4], [5]. Therefore, accurately modeling patient-specific blood flow may improve understanding and prevention of post-TAVR thrombosis [6]. Computational modeling approaches, such as computational fluid dynamics (CFD) and fluid-structure interaction (FSI), have been used to evaluate local blood velocity and pressure; however, these methods are time-consuming and computationally intensive.

In contrast, Doppler ultrasound is a widely available experimental method, but it is inaccurate for measuring local blood velocity [7]. Other imaging modalities, such as magnetic resonance imaging (MRI), are less accessible, costly, and lack sufficient resolution for assessing local blood velocity. Particle image velocimetry (PIV) is a

technique that provides high-resolution, time-resolved flow data in in-vitro, particle-seeded systems. However, generating clinically relevant data requires accurate physical phantoms that replicate patient-specific anatomy and hemodynamics. Limitations in manufacturing capabilities and the requirement for optical transparency in PIV-compatible models restrict the resolution and clinical relevance of these phantoms.

To address this, we developed an affordable method for generating high-fidelity aortic models to investigate the relationship between anatomical and hemodynamic factors in post-TAVR thrombus formation risk. We cast polydimethylsiloxane (PDMS) over a set of sacrificial cores, which were designed in Blender using a CT scan of an aortic root. Extensions were added for the left ventricular outflow tract and aortic sinuses to serve as the model's inlet and outlet. Additional extensions were included for pressure transducer placement.

The cores and casting boxes were 3D printed using extrusion printers and smoothed to create a surface suitable for PIV [8]. The two cores were held in place by resin-printed leaflets made from biomedical elastic 50A resin. The aortic model was then placed in a custom-built mock circulatory loop consisting of a pulsatile piston pump, a compliance chamber, a resistance valve, and an elevated open-air reservoir. The pulsatile pump was set to deliver 83 mL per beat at 75 beats per minute.

We measured left ventricular and aortic pressures over 20 cardiac cycles and averaged the results. With this circulatory setup, we obtained average pressure differences of 125 mmHg (range: 0-125 mmHg) for the left ventricle and 35 mmHg (range: 80-125 mmHg) for the aorta. These values are consistent with physiological measurements reported in experimental studies [9], [10].

The next step in this project is to incorporate PIV to investigate how patient-specific geometries influence thrombosis risk in post-TAVR patients.

133 - TOUCH-SPUN MICROFIBER SCAFFOLDS: A PROMISING PLATFORM FOR TISSUE ENGINEERING APPLICATIONS

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The increasing demand for reliable 3D cell culture platforms—both for the large-scale expansion of adherent cells and for the development of structured tissues—has spurred interest in scalable and reproducible scaffolding technologies. In this study, we present a novel approach to fabricating a biodegradable and accessible scaffold for 3D cell culture using aligned cellulose acetate (CA) microfibers, produced through touch-spinning (CytoNest, Inc.). Our technology offers significant advancements, including the material's biocompatibility and accessibility, the capacity for cells to align along the fibers, and the reproducibility of the method compared to conventional techniques. In this research, we fabricated fibrous sheets with a fiber thickness of up to 2 μm and uniform interfiber spacing. These sheets were assembled into 2D and 3D multi-layered structures using additive manufacturing. To create highly biocompatible cellulosic materials, the CA-based samples underwent partial alkaline hydrolysis in a 0.1 M NaOH solution. We characterized the fibers using various techniques, including infrared spectroscopy, scanning electron, and atomic force microscopy. The in vitro performance of the scaffolds was evaluated by culturing NIH/3T3 GFP fibroblasts and the DLEC line. To enhance cell attachment to the fibers, the scaffolds were treated with plasma, resulting in an increased number of reactive groups that interact with cell surface proteins. The plasma treatment promoted initial cell attachment and enabled the formation of dense, aligned cell cultures, as confirmed by the staining of cell actin and nuclei.

134 - REAL-TIME PATIENT SAFETY SYSTEM USING DEEP LEARNING

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Patient safety, especially for those under anesthesia or requiring continuous supervision, remains a critical concern within healthcare settings. For example, such patients may fall from hospital beds. Traditional patient monitoring methods, such as wearable sensors, bedside alarms, and direct human supervision, present notable challenges, including invasiveness, limited scalability, high operational costs, and privacy implications. To address these critical issues, this study introduces a real-time, non-intrusive monitoring system using the MediaPipe library and OpenCV, designed for precise human posture detection and tracking.

The proposed system captures live video feeds and systematically processes each frame by extracting 33 key anatomical landmarks of the human body. These landmarks enable detailed tracking of patient posture and movements with minimal intrusion. Clinicians define a Region of Interest (RoI), representing the expected safe zone or spatial

boundaries for patient mobility based on clinical safety guidelines. Real-time monitoring within this defined RoI allows the identification of critical behavioral deviations promptly.

The key contributions of this work are the design of three metrics for patient fall detection, and the development of a continuous monitoring system using the metrics. The metrics are: (1) Activity Level, quantifying the frequency and intensity of overall body movement; (2) Agitation Level, identifying rapid or erratic movements typically associated with distress or discomfort; and (3) Distance from RoI, measuring any deviation from the predetermined safe area. The integrated system promptly generates real-time alerts upon detection of significant anomalies, facilitating immediate medical intervention and enhanced patient safety.

Rigorous model training and evaluation were conducted utilizing an extensive custom dataset consisting of over one million rows of annotated landmark data, systematically extracted from pre-recorded video footage. Each row within this dataset represents specific landmark coordinates, labeled categorically according to patient posture (such as sitting or standing). Unsupervised clustering, employing the K-means algorithm with an optimal cluster number determined via the elbow method (k=7), identified inherent natural groupings based on spatial configurations of key joints.

The proposed methodology is designed with patient privacy as a foundational priority, retaining only numerical landmark coordinates rather than storing raw video footage. Validation efforts and practical feedback from healthcare professionals confirm the system's effectiveness, specifically highlighting its application for fall prevention significant issues in hospital environments due to the severe impacts of patient falls on healthcare outcomes and associated operational expenses.

Furthermore, this research incorporates an extensive literature review examining existing technologies utilized in patient monitoring, such as wearable devices, AI-powered surveillance, and motion detection systems. This review situates our approach within current scientific discourse, identifying existing gaps and emphasizing the necessity of our privacy-conscious, cost-effective, and scalable solution.

In conclusion, this research significantly advances toward the realization of autonomous, reliable, and efficient patient monitoring solutions, ultimately benefiting healthcare settings by reducing operational burdens and advancing the scientific understanding of real-time human posture detection and predictive analytics.

135 - SPINESEGGAN: AUTOMATIC SEGMENTATION OF LUMBAR SPINE

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INTRODUCTION: Lumbar spinal stenosis is one of the many diseases that occur in the lumbar spine, it is a narrowing or constriction in the lumbar spine. MRI is preferred for its diagnosis. To treat the disease, a surgery might be necessary, and surgeons need to know the different anatomical structures map prior to surgery. Researchers have tried to automate the segmentation of MRI images of the Lumbar Spine going as far back as 2014. However, a limited count of papers has been published in this domain that involve Artificial Intelligence / Machine Learning (AI/ML) on composite (T1 + T2) images, and are available publicly for reproducibility and comparison.

OBJECTIVES: The objective of this research was to perform comparative evaluation of state-of-the-art AI/ML methods for segmentation of Lumbar Spine Stenosis. **DATA:** A publicly available dataset was selected, named Lumbar Spine MRI Dataset, for reproducibility. The dataset consisted of 1,545 composite T1 and T2 MRI images (combined) in the axial view. The combined images were of 515 patients. **METHODS:** Our methods for comparison were basic U-Net, V-Net, and Pix2Pix Generative Adversarial Networks (Pix2Pix GAN). We improved the Pix2Pix GAN using U-Net (ResNet-50 backbone) as a generator, and a 5-layer deep CNN as a discriminator for the Pix2Pix GAN. Subsequently, we improved the discriminator of the Pix2Pix GAN using a Swin Transformer. Hyperparameter optimization was performed to find out the optimum number of layers and optimum value of parameters. Our metric was the Dice Score. **RESULTS:** Our results look promising; we got 0.93 (Dice score) with our improved model. The paper that released this public dataset had an overall IoU of 0.854 with SegNet. To the best of our knowledge, these are the only studies that used composite images (T1 + T2) for segmentation on this public, reproducible dataset. **SIGNIFICANCE:** Our work is significant as it compares state-of-the-art methods on a benchmarked dataset, systematically, in this domain. For future work, we plan to validate our model on other public, reproducible datasets, if available. By segmenting the MRIs automatically, we can assist the surgeons in planning the surgery, faster and more accurately.

136 - CHITOSAN-HYDROGEL SUPPLEMENTS FOR ENHANCED PLANT TOLERANCE: A COMPUTATIONAL FRAMEWORK FOR TEMPERATURE-TRIGGERED WATER AND NUTRIENT RELEASE

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Background: Heat stress and drought increasingly constrain crop yields by depleting soil moisture and limiting nutrient uptake. Conventional fertilizer and irrigation strategies typically fail to synchronize resource delivery with plant demand during extreme stress events. Stimulus-sensitive hydrogels, especially chitosan-based networks, offer a compelling "self-deploying" solution: they swell with water and nutrients under normal conditions, then release their payload when environmental cues (e.g. rising temperature or falling soil moisture) signal impending drought. **Methods:** We propose a computational framework to guide the design of chitosan-hydrogel supplements that discharge stored water and encapsulated fertilizer (e.g. urea or NPK) upon reaching a threshold temperature (~32-35 °C). Two candidate formulations are evaluated: a chitosan-citric acid-urea resin (CHCAUR) and a thermo-responsive PNIPAM-chitosan composite. Published release profiles were digitized and fitted, via non-linear regression, to five kinetic models: zero-order, first-order with an asymptotic limit, Higuchi, Korsmeyer-Peppas, and Weibull. Models were ranked by their coefficient of determination (R^2). **Rationale:** Selecting the simplest model that still achieves high fidelity is crucial for reliable design. The first-order model with an asymptotic release limit, which represents diffusion-driven expulsion from a contracting hydrogel network, fits both CHCAUR and PNIPAM-chitosan data exceptionally well ($R^2 \geq 0.95$), outperforming all alternatives. Its two parameters, a rate constant (k) and a maximum releasable fraction, have clear physical interpretations, enabling straightforward tuning of hydrogel composition and geometry to achieve desired release timing. Embedding this model into a soil-plant simulation allows in silico optimization of hydrogel dosage and trigger thresholds so that water and nutrients become available precisely when soil moisture falls below critical levels and temperatures exceed stress thresholds. **Future Research:** Ongoing work will refine kinetic parameters, extend simulations to multi-day drought cycles, and couple release outputs with crop-growth models. These efforts will validate and hone the computational design rules, paving the way for field-ready, smart chitosan-hydrogel supplements that boost drought tolerance and promote sustainable crop production.

137 - DEVELOPMENT OF pH-RESPONSIVE HYDROGELS FOR PLANT STRESS SENSING APPLICATIONS

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Plants under environmental stress exhibit pH changes tied to hormone response mechanisms, creating an opportunity for sensing pH changes and targeted delivery systems that respond to these shifts. Previous work with pH-responsive materials has primarily focused on medical applications, with limited exploration in agricultural contexts. We aimed to develop a hydrogel capable of responding to stress-induced pH changes for targeted delivery of phytohormones. We began by screening alginate-chitosan combinations, which showed insufficient sensitivity centered around pH 6.5. After further literature review, we shifted to alginate-polyacrylamide (PAAm) interpenetrating networks, synthesized using a 1:6 weight ratio of alginate to polyacrylamide (10-15% with acrylamide/bis-acrylamide at 37.5:1). 10ul of each initiator (TEMED and APS 10%) were used. Our two-step synthesis involved polymerizing acrylamide with alginate present, followed by calcium chloride crosslinking. Initial observations confirmed visible size differences in our hydrogel beads between pH 4 and pH 10 conditions. The hydrogel beads in pH 4 solution exhibited about 190.1% of weight increase in 24 hours, whereas pH 10 solution led to only 12.6% weight increase of the beads after 24 hours. To enable standardized mechanical characterization, we designed and 3D printed custom ASTM-compliant testing molds capable of producing nine dogbone specimens per batch. This work establishes a foundation for smart delivery systems that could respond to plant stress signals, enabling controlled delivery of therapeutics in response to environmental conditions. Future work will quantify swelling behavior and mechanical properties across pH conditions.

138 - In vivo NEURON-SPECIFIC DELIVERY OF BIOMOLECULES

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Efficient delivery of biomolecules into neurons has significant impacts on therapeutic applications in the central nervous system (CNS) and fundamental neuroscience research. Existing viral and non-viral delivery methods often suffer from inefficient intracellular access due to the endocytic pathway. Here, we discover a neuron-targeting and direct cytosolic delivery platform by using a 15-amino-acid peptide, termed the N1 peptide, which enables neuron-specific targeting and cytosolic delivery of functional biomolecules. The N1 peptide initially binds hyaluronan in the extracellular matrix and subsequently passes the membrane of neurons without being trapped into endosome. This mechanism facilitates the efficient delivery of cell-impermeable and photo-stable fluorescent dye for super-resolution imaging of dendritic spines, and functional

proteins, such as Cre recombinase, for site-specific genome modification. Importantly, the N1 peptide exhibits robust neuronal specificity across diverse species, including mice, rats, tree shrews, and zebra finches. Its targeting capability is further demonstrated through various administration routes, including intraparenchymal, intrathecal, and intravenous (i.v.) injections after blood-brain barrier (BBB) opening with focused ultrasound (FUS). These findings establish the N1 peptide as a versatile and functional platform with significant potential for bioimaging and advanced therapeutic applications.

139 - POLYMERIC MICELLES FOR CONTROLLED DELIVERY OF REACTIVE SULFUR SPECIES

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Reactive sulfur species including hydrogen sulfide (H_2S) and per/polysfulide species (H_2S_n, RS_nH, $RS_{n+1}R'$, $n\geq2$) serve as signal mediators in many cellular processes in the human body. Accumulating evidence shows that these species are essential for regulating cardiovascular, neural and immune systems. Despite the therapeutic implications of these sulfur species, the lack of the efficient and safe delivery systems hampers translation of their biological activities into clinical applications. To address this issue, my group has developed novel delivery systems based on polymeric nanomedicines. In this talk, the concept and design criteria for polymeric micelles bearing H2S donating anethole dithiolethione (ADT) groups for H2S delivery will be discussed. By modulating the structural stability of the micelles, we successfully controlled the H_2S release rates in physiological buffer and cells. The release rate significantly affected the biological activities in endothelial cells and cancer models. We next present a novel approach to generate per/polysulfide species in cells by combining a H_2S donor and manganese porphyrin-containing polymeric micelles (MnPMCs) that catalyze oxidization of H_2S to per/polysulfide species. MnPMCs catalyzed the conversion of H_2S to per/trisulfide species in a physiological buffer solution and cells. Furthermore, co-treatment with ADT (H_2S donor) and MnPMCs showed stronger proangiogenic effects in human umbilical vein endothelial cells (HUVECs) compared to ADT treatment alone. These findings underscore the potential of polymeric micelle-based delivery systems AS INNOVATIVE PLATFORMS FOR CONTROLLED DELIVERY OF SULFIDE SPECIES.

140 - TARGETING RIBOSOME BIOGENESIS IN CANCER THERAPY

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Human pancreatic cancer (PanCa) is one of the most aggressive malignancies, with very limited therapeutic options that typically involve a combination of surgery, chemotherapy and targeted therapy. Thus, developing new treatment strategies is an urgent medical need for the management of PanCa. In this study, we explored the therapeutic potential of BMH-21, a pharmacological inhibitor of RNA polymerase I (Pol I), against PanCa by uncovering a novel molecular mechanism involving interaction of RPA194 mediated ubiquitination of mutant p53 without affecting wild-type p53. Our key findings include i) BMH-21 selectively induces apoptosis and cell growth inhibition of PanCa cells with no effect on normal human pancreatic ductal epithelial cells (HPDEC), ii) degrades RPA194 protein, iii) inhibits recruitment of both RPA194 and RPA135 on rDNA to suppress pre-rRNA synthesis, iv) RPA194 physically interacts with p53 and BMH-21-induced degradation of RPA194 selectively exposes truncated and mutated p53 for ubiquitination with no effect on wild-type p53 in PanCa cells and v) BMH-21 treatment significantly reduces the growth of orthotopic xenograft pancreatic tumors in athymic nude mice with no observe toxicity. Altogether, these findings suggest that BMH-21 is a promising, non-toxic therapeutic agent for PanCa patients with aberrant ribosome biogenesis and mutant p53, offering a potential new avenue for targeted treatment.

141 - ZINC-INTEGRATED PLGA/CHITOSAN NANOFIBER COMPOSITES MESHES: FABRICATION AND CHARACTERIZATION FOR POTENTIAL BIOMEDICAL APPLICATIONS

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Zinc (Zn) is a promising material for wound healing applications due to its ability to promote cell proliferation, angiogenesis, and antimicrobial activity through the release of Zn^{2+} ions during degradation. Moreover, Zn implants can disintegrate at rates matching tissue recovery. This study incorporated Zn nanoparticles into electrospun nanofiber meshes composed of poly (D,L-lactic-co-glycolic acid) (PLGA) and PLGA/Chitosan (PLGA-CH) to evaluate their potential for wound healing and tissue repair. Composite meshes were fabricated via electrospinning and characterized for fiber morphology, chemical composition, mechanical properties, and Zn^{2+} release profiles. Zn incorporation modified the physical properties of PLGA without altering its chemical structure and enabled dose-dependent Zn^{2+} release. Biological evaluation using 3T3 fibroblasts over three days revealed a fiber composition-dependent cytotoxic effect, with specific formulations supporting robust cell proliferation. Additionally,

incorporating low concentrations of chitosan improved the biocompatibility of the meshes. These findings demonstrate that tuning Zn content and polymer composition can optimize scaffold performance for wound healing applications. Future in vivo studies are warranted to further assess the therapeutic potential of these Zn-integrated nanofiber meshes as advanced wound dressings.

142 - NEUROMODULATION OF THE BASAL NUCLEUS OF MEYNERT: UNRAVELING THE EFFECT OF STIMULATION PATTERNS AND COGNITIVE STATES

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Background. The nucleus basalis of Meynert (NBM) plays a critical role in attention, learning, and memory. Its widespread cholinergic projections are the primary source of Acetylcholine (ACh) to the entire neocortex and amygdala. The progressive loss of NBM is a crucial hallmark of Alzheimer's and Parkinson's disease dementia. NBM has been shown to facilitate learning by altering ACh release, which in turn modulates the neuro-excitability and spectral topography in the neocortex. In addition, the GABAergic and glutamatergic projections from the basal forebrain also have a pivotal effect on intra-cortical signaling/ oscillations. NBM neurons have also been reported to alter their firing patterns under different cognitive processes. This study assesses the impact of different NBM stimulation patterns on the NBM-cortical network, behavioral responses, and histological patterns. ***Methods. (i)*** Various NBM stimulation parameters (electrical and optogenetics) were tested in anesthetized adult rats. Default DBS parameters were cathodic monopolar pulse with phasic patterns, ten pulses per train with 100ms train duration, train frequency of 100 Hz (intra-burst or inter-pulse frequency, IPF), and train repetition rate of 4 Hz (inter burst frequency, IBF). ***(ii)*** In a separate experiment, the NBM-local field potential (LFP) and EEG from the auditory cortex (A1) were recorded from tethered normal, memory impaired, and stimulated memory impaired (50 Hz tonic stimulation, or delta-gamma-burst stimulation for 1, 5, or 24 hours) rats during the presentation of audio tones. ***(iii)*** In a follow-up experiment, memory impaired rats were tested and stimulated with similar paradigm using visual operant learning tasks. The brains were processed for immunohistology. ***Results. (i)*** When *different IBFs* were tested, we saw a peak in the theta power at the 4-6 Hz range with the corresponding decrease in delta (fig 3a). The drastic reduction at 2 and 6 Hz indicates the circuitry's resonance sensitivity. Different gamma power distribution as well as correlation among the cortical channels was observed as well. Similarly, for *different IPFs*, the same pattern of a peak in theta and reduction in the delta was found at an IPF of 50-60 Hz (fig 3b). *The pulse-width* response was maximized at 6-8 ms. ***(ii)*** The delta (0.5-5 Hz) and alpha band (9-15 Hz) show significantly higher relative power during resting compared learning, exploring, or attention tasks ***(iii)*** ChAT cell counts in 17 rats were correlated with performance in an auditory learning task. Both naïve and demented rats showed a strong linear correlation ($R = 0.83$, $p < 0.05$) between ChAT count and task improvement, while stimulated rats improved regardless of low ChAT counts. ***Conclusion.*** We believe that the correlation between ChAT cell counts and learning task improvement shows that the developed burst stimulation restores the capability to learn a task and affects the generation of cells in the brain associated with learning. We are further studying the differential effect of stimulation during sleep/wake cycle and learning stages.

143 - GENOME MINING GUIDED METABOLOMICS STUDY TO DISCOVER NEW THERAPEUTICS

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Actinomycetes are a rich source of secondary metabolites with a diverse range of biological activities. The genus *Saccharopolyspora* has been recognized as a potential source for diverse classes of natural products. It is a pharmaceutical genus that could provide further chemical diversity with potential lead compounds. The genome of *Saccharopolyspora Spinosa* was analyzed by antiSMASH, and 36 biosynthetic gene clusters (BGCs) were identified. In this study, the spinosyn BGC was deleted in *Sa. spinosa* ATCC83543.1 uses the heat-sensitive vector pKC1139 to generate the mutant strain *Sa. spinosa*ΔSPN. HPLC analysis of methanolic extract of shake flask fermentation of this strain showed the presence of new metabolites. The crude extract was then analyzed through tandem mass spectrometry. Analysis of raw data of LC-MS/MS using MestroNova and SIRIUS software identified cyclodepsipeptides (surfactin A, surfactin B, surfactin C, lipopeptide NO) as a major product; in addition, gageostatin A was also identified. In similar study, we have found vidarabine, 3-isobutylhexahydropyrrolo[1,2-a]pyrazine-1,4-dione, N-(2-phenylmethyl) acetamide, linoleamide, etc. in *Nocardia* species (nargenicin deleted mutant); particularly peucemycin in *Streptomyces peucetius* DM07 (doxorubicin deleted mutant).

144 - NEONATAL INFLAMMATION CAUSES SEX-SPECIFIC EFFECTS ON ATTENTION-

DEFICIT/HYPERACTIVITY DISORDER (ADHD)-LIKE BEHAVIORS, AND HOMEOSTATIC RESPONSES TO SLEEP DISTURBANCES IN ADOLESCENT RATS USING MACHINE LEARNING-BASED ANALYSIS

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Perinatal exposure to inflammation may play an important role in the association between sleep disturbances and neurodevelopmental disorders such as attention-deficit/hyperactivity disorder (ADHD) development. This study examined whether machine learning-based pattern analysis identified sleep patterns associated with ADHD in juvenile rats exposed to perinatal inflammation and sleep disruptions. Intraperitoneal injections of lipopolysaccharide (LPS) (2 mg/kg) or saline were administered on postnatal day 5 (P5) to Sprague-Dawley male rat pups, followed by behavioral testing at P35, implantation of a sleep recording electrode on P39, and exposure to sleep disruptions on P47. Baseline sleep, sleep disruption, and recovery sleep were recorded on P46, P47, and P48, respectively, for 24 hours. Four groups (n=5/sex/group) were included in this study: Saline-Baseline, Saline-Recovery, LPS-Baseline, and LPS-Recovery. Our results showed that neonatal LPS treatment induced ADHD-like behaviors, including hyperactivity and inattention at P35 in both male and female rats, and had a higher effect on males. Neonatal LPS treatment interfered with REM sleep and sleep homeostatic responses (recovery sleep) to sleep disturbances in adolescent rats (P49). Six unsupervised machine learning models were applied to analyze the feature interaction patterns among the collected high-dimensional sleep data. Our approaches identified relative theta power and relative spindle power as features significantly associated with ADHD and perinatal inflammation in this experimental model of sleep disruption in male rats. These results suggest that machine learning-based analysis could serve as a strong tool in identifying neurodevelopmental disorders utilizing sleep data in subjects exposed to perinatal inflammation and sleep disruptions. In addition, these results could help in developing new treatments for sleep disorders associated with ADHD.

145 - INTRANASAL INSULIN PROTECTS AGAINST BRAIN INJURY AND IMPROVES SENSORIMOTOR DYSFUNCTION FOLLOWING HYPOXIA-ISCHEMIA IN P5 NEONATAL RATS

Madison Klim[1], Carolyn Glendye[1], Jonathan Lee[1], Elizabeth White[1], Valerie Quach[1], Nilesh Dankhara[1], Silu Lu[1], Shuying Lin[2], Norma Ojeda[3], Gene Bidwell III[4], Yi Pang[1], Lu-Tai Tien[5], Michelle Tucci[6], Abhay Bhatt[1], Lir-Wan Fan[1]

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Currently, as only supportive therapy is available for premature infants (less than 36 weeks gestation) with hypoxic-ischemic encephalopathy (HIE), there is an urgent need for effective therapies to improve outcomes of premature infants with HIE. Our previous studies in P10 neonatal rats showed that intranasal insulin (InInsulin) administration provides neuroprotection against hypoxia-ischemia (HI)-induced brain injury —a finding that holds promise for full-term human infants. The objective of the present study is to examine whether a novel therapy, InInsulin, protects against brain injury, inflammation, and sensorimotor behavioral dysfunction following HI in postnatal day 5 (P5) rats, which corresponds to the brain developmental stage of premature infants. Recombinant human insulin (rhInsulin) (25 µg/5µl), fluorescence-tagged insulin (Alex-546-insulin) (25 µg/5µl), or an equivalent volume of vehicle (phosphate-buffered saline) was administered to each nostril in P5 Sprague-Dawley (SD) rat pups. Pups were sacrificed 15 minutes after rhInsulin or Alex-546-insulin administration and rhInsulin levels in the

brain were determined by ELISA and ex vivo whole-brain imaging (IVIS), respectively. ELISA results demonstrated measurable rhInsulin levels in different brain regions 15 min after insulin administration. Widespread Alex-546-insulin-binding cells were detected in the brain, primarily co-localized with neuronal nuclei-positive neurons. Activated Phospho-Akt was detected in Alex-546-insulin double-labeled cells, suggesting activation of the Akt/PI3K pathway in the brain. An additional P5 SD rat pups were randomly divided into four groups, and pups either had HI by permanent ligation of the right carotid artery followed by 90 min of hypoxia or Sham surgery followed by room air. Immediately after HI or Sham procedure, rat pups were administered rhInsulin (25 µg/5µl) or an equivalent volume of the vehicle in each nostril. Sensorimotor neurobehavioral tests and brain injury were determined on P6. InInsulin attenuated HI-induced sensorimotor dysfunction at P6. InInsulin reduced HI-induced inflammation by decreasing elevated serum IL-1β, IL-6, and TNFα levels, and ipsilateral brain IL-1β levels and Iba1+ microglia numbers. InInsulin also reduced HI-induced brain injury, including a reduction in ipsilateral brain volume and NeuN+ mature neuronal cell loss, and increased cleaved caspase 3+ and Fluoro-Jade C+ neurons in the P6 rats. No sex-specific response was noted. These findings indicate that InInsulin is neuroprotective against P5 HI-induced brain injury, brain inflammation, and sensorimotor neurobehavioral disturbances in neonatal rats associated with activation of intracellular cell survival signaling. Our results provide strong evidence in support of InInsulin as a non-invasive therapy to improve outcomes of premature newborns with HIE.

146 - NEONATAL LIPOPOLYSACCHARIDE EXPOSURE ENHANCES METHAMPHETAMINE-INDUCED ALTERATIONS IN THE DOPAMINE TRANSPORTER AND REINSTATED BEHAVIORAL SENSITIZATION IN ADULT RATS ANALYZED WITH EXPLAINABLE MACHINE LEARNING

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To investigate the effect of neonatal systemic LPS exposure-induced dopaminergic injury, we used our neonatal rat model of systemic lipopolysaccharide (LPS) exposure (1 or 2 mg/kg, intraperitoneal injection in postnatal day 5 male rats) to examine methamphetamine (METH) sensitization as an indicator of drug addiction in adult rats. On P70, animals began a treatment schedule of 5 daily subcutaneous (s.c.) administrations of METH (0.5 mg/kg) (P70-P74) to induce behavioral sensitization. Ninety-six hours after the 5th treatment with METH (P78), animals received 0.5 mg/kg METH (s.c.) to reintroduce behavioral sensitization. A random forest model was used as the detector to extract the feature interaction patterns among the collected high-dimensional locomotor data. Our approaches identified neonatal systemic LPS exposure dose and METH-treated dates as features significantly associated with methamphetamine-induced behavioral sensitization, reinstated behavioral sensitization and perinatal inflammation in this experimental model of drug addiction. Neonatal LPS exposure also enhanced METH-induced reduction of dopamine transporter (DAT) expression, decrease in mitochondrial complex I activity, and increases in the interleukin-1β concentration in the P78 rat striatum. These results indicate that neonatal systemic LPS exposure produces a persistent lesion in the dopaminergic system which leads to a long-lasting change in the brain reward system as indicated by enhanced METH-induced behavioral sensitization and reinstated behavioral sensitization later in life. These findings show that early-life brain inflammation may enhance susceptibility to the development of drug addiction later in life, which may be associated with chronic inflammation-induced striatal mitochondrial dysfunction and alterations in striatal DAT expression.

147 - MICROGLIAL SUPPRESSOR AZITHROMYCIN PROTECTS AGAINST NEONATAL SYSTEMIC LIPOPOLYSACCHARIDE-INDUCED BRAIN INFLAMMATION AND PRE-SOCIAL INTERACTION IMPAIRMENTS IN NEONATAL RATS

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Increasing data provide support for the hypothesis that microglia activation-related pro-inflammatory cytokines mediate inflammation-induced injury to the neonatal brain. Our previous studies have shown that systemic administration of endotoxin lipopolysaccharide (LPS) induces sensorimotor neurobehavioral dysfunction and brain inflammation in neonatal rats, which is associated with the production of pro-inflammatory cytokines by activated microglia. The objective of this study was to determine whether azithromycin, a suppressor of microglial activation, reduces brain inflammation and neurobehavioral disturbances caused by systemic LPS administration. Postnatal day 5 (P5) Sprague-Dawley rat pups were given an intraperitoneal (i.p.) injection of LPS (2 mg/kg) or sterile saline. 5 minutes later, azithromycin (40 mg/kg) or vehicle (PBS) was injected. On P6, 24 hours after LPS administration, neurobehavioral tests were performed, and brain inflammation and oxidative stress markers were measured. Our results showed that azithromycin significantly reduced LPS-induced reduction in body temperature and neurobehavioral deficits, such as decreases in pre-social interaction (ultrasonic vocalization), allodynia, hyperalgesia, and sensorimotor neurobehavioral deficits in P6 rats (n=12/sex/group, $p<0.05$). Azithromycin also significantly reduced LPS-induced brain injury as indicated by the reduction in brain size and increases in brain ventricle size in P6 rats (n=6/sex/group, $p<0.05$). Neonatal systemic LPS-induced increases in interleukin-1b levels and thiobarbituric acid reactive substances (TBARS) contents in the P6 rat brain and spinal cord were also attenuated by azithromycin treatment (n=6/sex/group, $p<0.05$). These results suggest that microglial suppressor azithromycin may provide protection against systemic LPS exposure-induced brain injury, inflammation, lipid peroxidation, and neurobehavioral dysfunction, and that the protective effects are associated with its ability to reduce LPS-induced microglia activation-related pro-inflammatory cytokines.

148 - TAKING PROJECTS TO THE NEXT LEVEL: FROM IDEAS TO ENTREPRENEURSHIP

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Many engineering students graduate with promising ideas and innovative projects, yet few proceed to transform them into viable businesses, particularly within the complex and highly regulated biomedical industry. In this presentation, I will offer practical strategies for bridging the gap between technical innovation and entrepreneurship, drawing upon my experience founding and leading two medical technology companies. I will discuss how to identify genuine clinical needs, validate potential solutions, navigate early regulatory and funding challenges, and assemble a team capable of effective execution. Whether students are engaged in a capstone project, conducting research, or exploring a startup concept, this session will provide a structured framework for converting engineering insights into impactful ventures.

149 - AI-ENHANCED OPIOID DETECTION WITH CGM BIOSENSORS

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This presentation introduces a novel approach to opioid detection using continuous glucose monitoring (CGM) technology, enhanced by artificial intelligence. Our research explores the use of CGM sensors to identify the presence and concentration of opioid-based analgesics in interstitial fluid, based on analysis of published clinical pharmacokinetic data. We developed and validated governing equations that estimate opioid concentrations with a mean error of less than 9%. In addition, a limited in vivo study involving human participants was conducted to detect acetaminophen concentrations, serving as a surrogate marker for combination opioid medications. An AI model was trained to interpret temporal concentration data, learning individual patient metabolism patterns, establishing baselines, and accounting for confounding variables such as meals and activity. This adaptive system enables accurate approximation of both the timing and dosage of administered medications, offering a promising tool for real-time, noninvasive therapeutic monitoring.

150 - INTEGRATED COMPUTATIONAL STRATEGIES FOR ACCELERATED DRUG DISCOVERY AGAINST GLOBAL HEALTH THREATS

Eneye Ajayi, Mostafa Aref, Md Emran Hossain, Rokaia Abdullah, Ling Yang, Yinan Wei, Hamed Ali

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Introduction: Drug discovery has traditionally been a complex and labour-intensive process, often driven by trial and error. However, computational methodologies have significantly transformed this landscape, accelerating timelines, enhancing accuracy, and reducing costs. Since the successful development of Saquinavir in 1995, the first FDA-approved drug discovered using structure-based computational design, to the more recent repositioning of Remdesivir for COVID-19 treatment, computer-aided drug discovery (CADD) has consistently demonstrated its potential to streamline the discovery process and cut research and development costs. **Methods:** In this study, we used an integrated computational approach—combining structure-based drug design (SBDD), ligand-based drug design (LBDD), and machine learning (ML) to discover novel therapeutics targeting breast cancer brain metastases (BCBM) and antimicrobial resistance, two urgent global health challenges. **Results:** A combination of quantitative and qualitative machine learning (ML) algorithms, guided by a benchmark of physicochemical parameters derived from a curated dataset of approved CNS drugs, identified HA25—a kinase inhibitor (KI) from our in-house library, with potential for blood-brain barrier (BBB) penetration. ML-driven, structure-based optimization of HA25's physicochemical properties led to the discovery of HA149, which exhibited effective permeability (Pe) of 73nm/s, an impressive 250-fold increase. Furthermore, *in vitro,* kinase assays showed that HA149 achieved 90% inhibition of HER2 at a 10 µM concentration and demonstrated potent cytotoxicity against MCF-7 and BT-549 breast cancer cell lines. In another successful CADD application, we modelled and elucidated the binding mechanism of demethylmenaquinone methyltransferase (MenG), a novel bacterial target. Using SBDD, we repurposed an in-house kinase KI as a MenG-targeting antibacterial agent. Initial single-strain screening of the optimized compound, HA163, against methicillin-resistant *Staphylococcus aureus* (MRSA) showed a minimum inhibitory concentration (MIC) of 0.25 µg/mL, a 100-fold improvement over the parent KI. Further screening against multidrug-resistant strains revealed that HA163 demonstrated potent activity against several strains of *vancomycin-resistant Enterococcus* (VRE), with an MIC of 0.25-0.5 µg/mL, which is about 250 to 500 times more potent than levofloxacin. *In vitro* toxicity assays showed minimal cytotoxicity of HA163 against normal human cells, indicating strong bacterial selectivity. **Conclusion:** These findings underscore the potential of integrated computational strategies to rapidly identify novel therapeutics for urgent challenges like BCBM and antibacterial resistance. Ongoing animal studies and lead optimization aim to validate these findings and support the patent application and clinical advancement of HA149 and HA163.

151 - SMARTPHONE-ENABLED POINT OF CARE SENSING AND IMAGING TOOLS FOR MEDICAL APPLICATIONS

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New approaches in micro- and nano-fabrication methods have advanced semiconductor technology, improving the quality and capabilities of communication devices and sensors. These fabrication methods can also be used to advance biosensors and create new technologies to advance healthcare and make them accessible and affordable to whole people across the world. In this talk, I will present our latest research findings and custom-developed technologies, focusing on lab-in-a-palm technologies and wearables. These cost-effective technologies are smartphone-enabled and aim to be used at the point of care for medical applications. The performance of these devices was tested using in vitro models and lab-prepared samples and validated using clinical samples collected from human participants.

153 - AI-ENHANCED WEARABLE SENSING PLATFORM: REAL-TIME PHYSIOLOGICAL MONITORING AND NANOGENERATOR MATERIAL OPTIMIZATION FOR SELF-POWERED OPERATION

Md Adil Hossain, Mohammad Solaiman, Md Masud Rana, Shawana Tabassum

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Aims: This research aims to develop a multi-stage framework (as shown in Figure 1 below), spanning real-time sweat electrolyte detection, ML-guided physiological inference, and intelligent self-powering via ML-guided materials discovery and fabrication, establishes a robust, AI-powered wearable sensing platform. The system holds significant promise for supporting health monitoring in construction workers, emergency responders, and athletes under high-stress, dynamic environments. **Research Methodology and Results:** In this study, we present the development of a cost-effective, flexible, and wearable potentiometric sensor for real-time detection of electrolytes (e.g., sodium ions (Na^+)) in human sweat, combined with an artificial intelligence (AI) framework to assess physiological stress, fatigue, and dehydration to improve the safety & health of workers. The sensor was fabricated using a low-cost screen-printing method to ensure

scalability and batch uniformity. Laser-induced graphene (LIG) was used as the working electrode due to its high conductivity and surface area, while a silver/silver chloride (Ag/AgCl) electrode coated with polyvinyl butyral (PVB) served as the reference electrode, offering improved stability and resistance to Cl^- ion leakage. The Na^+ ion-selective membrane was formulated by dissolving 6.675 mg of sodium ionophore X, 436.325 mg of bis(2-ethylhexyl) sebacate (DOS), 220 mg of poly(vinyl chloride) (PVC), and 3.675 mg of sodium tetrakis-[3,5-bis(trifluoromethyl)phenyl] borate (NaTFPB) in 5 mL of tetrahydrofuran (THF). This membrane was drop-casted onto the working electrode to ensure effective sodium ion recognition. The sensor was extensively characterized for electrochemical performance through resistance measurements, confirming high conductivity and repeatability across sensors. Calibration curves showed excellent linearity across sodium concentrations ranging from 1 mM to 100 mM, with the highest response of 55 mV for 100 mM and the lowest response of -1.2 mV for 1 mM Na^+ concentrations. The sensor is expected to demonstrate high selectivity against interfering ions such as Mg^{2+}, Ca^{2+}, and K^+, and to maintain stable voltage outputs under mechanical bendinpg at 0°, 90°, and 180°, which will confirm its robustness during human movement. Long-term stability testing is also planned to validate the sensor's suitability for continuous real-time applications. The sensor is planned to be tested in human subjects in the coming months.

Furthermore, we are developing an AI-based machine learning pipeline to translate sodium ion concentrations in the sweat into meaningful physiological insights. Sweat data are being collected under IRB-approved protocols, and we are working on extracting features such as mean and peak sodium levels, rate of change, variability, and cumulative sodium loss [1]. Additional contextual inputs, including season, environmental temperature, estimated energy expenditure (based on task type and duration), and individual body mass, are being incorporated to enhance predictive performance. These features are informed by a large-scale retrospective analysis (n = 1,944 sweat tests), which highlights energy expenditure, seasonality, air temperature, and sweating rate as significant contributors to sweat sodium variability [2]. We are currently training supervised ML models (Random Forest, SVM, and Gradient Boosting) to classify physiological stress levels and predict fatigue and dehydration status. To better understand model behavior, we are conducting SHAP (Shapley Additive exPlanations) analysis, which is a method that quantifies the contribution of each input feature to the model's predictions to identify the most influential predictors, such as sodium rate of change, ambient temperature, and energy expenditure. Preliminary results suggest that when contextualized with environmental and physiological metadata, sodium ion dynamics have strong potential to serve as digital biomarkers for real-time stress and fatigue detection.

In parallel, we are designing a fully autonomous version of the wearable sensor powered by a nanogenerator to eliminate dependency on bulky external power sources. We are building a machine learning-assisted selection process focused on ferroelectric halide perovskites to identify suitable materials for the nanogenerator. This process begins with developing a classification model based on a dataset curated from published literature, including materials characterized by single-crystal X-ray or phase-pure powder diffraction data. Each composition is represented by features such as tolerance factor, valence electron count, ideal bond length, Mendeleev number, and Martynov-Batsanov electronegativity—factors relevant to perovskite formability. We are currently training a support vector classifier with a radial basis function (SVC-RBF) kernel to distinguish materials likely to yield >95% perovskite phase purity. Promising candidates are then being evaluated using regression models combined with active learning to identify those with desirable ferroelectric properties, such as high Curie temperatures. Once top candidates are identified, we plan to synthesize and fabricate them into nanogenerators to validate their compatibility and energy harvesting performance in the wearable system.

154 - CHANGES IN DIABETIC KIDNEY FOLLOWING PLANT EXTRACT ADMINISTRATION

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Introduction. Diabetic nephropathy (Diabetic kidney disease) is a disease caused by diabetes and is a major health problem due to kidney damage. This disease results from chronic hyperglycemia and high blood pressure leading to chronic kidney failure due to changes in the kidney structure. In this study, we examined kidney damage in diabetic mice and tested a plant extract, *Hippocraeta Velutina* (HV), to evaluate its effectiveness on diabetic nephropathy. ***Materials and Methods***. CBL57 female mice at 10 weeks old were injected with either a citrate buffer or streptozotocin for 7 consecutive days. After 9 days mice with blood glucose levels above 200 mg/dL were considered diabetic and split into two groups: STZ (n=5) and STZ+HV (n=5). HV extract was given by mouth and after 2 weeks, the mice were sacrificed, and kidneys were collected for analysis. H&E staining was used to look at kidney tissues on a microscopic level. ***Results***. After

microscopic observations, diabetic kidneys looked very different from the control samples showing clear changes in the kidneys due to diabetes and possible effects of HV treatment. ***Acknowledgement.*** This work was supported by the NIH/NIHMD Grant U54MD015929 Research Project 6611 to MP at Jackson State University.

156 - MOTIVATIONAL APPROACHES, OUTCOMES, AND IMPLICATIONS IN MEDICAL EDUCATION

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Higher-level education, including medical school, can be a stressful period of a student's life due to the amount of complicated content that is required to learn in a short amount of time. Because of this stress, these students may exhibit increased levels of anxiety. Quek et al. (2019) determined that medical students display higher anxiety than the general public. It may be advantageous to employ a framework to help educators understand determinants of anxiety in medical students. One framework to understand determinants of anxiety is Achievement Goal Theory (AGT) which posits that students adopt goals of varying outcomes based on levels of perceived competence (PC). The 2×2 AGT framework distinguishes mastery-approach (MAP), mastery-avoidance (MAV), performance-approach (PAP), and performance-avoidance (PAV) goals. Literature suggests that avoidance goals are associated with higher anxiety and fear of failure (FOF). The purpose of this talk is to outline various motivational approaches students may adopt and possible outcomes associated with these goals, and to discuss implications for educators to help alleviate negative outcomes. Data will be discussed includes a sample of 97 first-year medical students were recruited to participate in this study. After providing consent, participants answered questions based on the variables of interest. The participants completed the AG Questionnaire, Failure Appraisal Inventory, Perfectionism Scale, Intrinsic Motivation Inventory, and the GAD-7 scales. Independent t-tests, correlations, and regression analysis were used to analyze the data. T-tests revealed that females reported higher FOF, perfectionism, and anxiety ($p < .05$); while males conveyed more PC ($p = .04$). The correlations showed significant relationships between anxiety and MAV goals ($r=.35$), PC, ($r=-.48$), FOF ($r=.39$), and perfectionism ($r=.36$). These variables were entered into a significant regression which predicted 43% of the variance with MAV and PC remaining significant. Data confirmed MAV, low PC, and FOF result in higher anxiety; similar to research (Dasinger & Solmon, 2019). Future research should focus on techniques to decrease FOF and increase competency. Implications for educators include the implementation of mastery climates and awareness of the importance of self-improvement for each individual student.

157 - COCULTURE OF HDFN AND HUVECS ON ZINC-FUNCTIONALIZED FIBROUS SCAFFOLDS

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Tissue vascularization remains a major challenge in regenerative medicine, particularly in the repair of damaged organs. Recent advances in tissue engineering highlight the pivotal role of fibroblasts in regulating angiogenesis. These cells contribute by synthesizing collagen, a key component of the extracellular matrix, and by secreting angiogenic factors that support endothelial cell proliferation and migration. In this study, an electrospun nanofibrous scaffold was developed. The in vitro bioactivity and cellular activities were evaluated using a co-culture of HUVECs and HDFn in indirect contact. An angiogenic assay was performed to assess the influence of HDFn on HUVEC viability, stabilization, spreading, assembly into a capillary-like structure, and protein expression. We found that in vitro indirect co-culture study improved HUVECs growth, proliferation, migration, tube formation, and immunocytochemistry. All these results showed that the controlled release of zinc from the nanofibrous scaffolds regulates cellular metabolism with differentiation. The secretion of soluble growth factors such as VEGF and bFGF by HDFn and the Zn ions improved the metabolic activity of HUVECs, inducing the formation of neovascularization, which was confirmed by the expression of vascular differentiation-specific markers, CD31 and VE-cadherin. In conclusion, these results indicate that the microenvironment created by HDFn modulates HUVECs to form capillary morphologies, stimulating angiogenesis in situ. They can potentially be used in tissue regeneration strategies and medical applications where vascularization is crucial.

158 - DEVELOPING ANTICANCER PROTEIN-PROTEIN INTERACTION INHIBITORS TARGETING HER2 RECEPTOR

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HER2 (Human Epidermal growth factor Receptor-2) is frequently upregulated and overexpressed in aggressive breast cancers, leading to increased proliferation, invasiveness, and poor patient prognosis. HER2 is a receptor tyrosine kinase belonging to the ErbB family of growth factor receptors. Activation of the kinase domains ismediated by HER2 dimerization, leading to an increase in

catalytic efficiency and initiation of the signaling cascadethat drives cancer progression. Current HER2 treatments work by binding to the extracellular domain to prevent dimerization or inhibiting the kinase domain at the ATP binding site. However, these strategies are prone to the development of drug resistance, highlighting the need fornovel inhibitors. In this study, we explored a new series of HER2-targeted compounds developed based on a previously identified hit inhibitor, UTF-H20323. Through molecular modeling, virtual docking software has identified compounds with similar binding patterns, and the top twelve, commercially available compounds were purchased for further studies. Initial screening was conducted using MTT cell viability assays in the HEK293 cell line to evaluate toxicity in a non-cancerous background. Five compounds showed minimal cellular toxicity and were advanced to the activity screen. Screening the HER2-positive SK-Br-3 breast cancer cell line indicated that the fives compounds were active, with some equally or more potent than UTF-H20323 at 100uM in a dose-dependent manner. Preliminary results suggest that these inhibitors hold potential for the development of HER2-targeted drugs with a novel allosteric mechanism of action.

159 - OVERCOMING BARRIERS TO NANOPARTICLES REACHING TUMORS VIA THE BLOODSTREAM AND OVERCOMING THE DEPTH LIMITATION OF LIGHT TO TRIGGER TUMOR EVENTS

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The journey from the intravenous injection site to the tumor is riddled with obstacles. First, as soon as a nanoparticle is administered into the blood stream the extraneous 'foreign' nanoparticle is tagged with opsonins that form a protein corona around the particle, flagging it for complement activation, engulfment by circulating macrophages, and rapid clearance from circulation. Second, upon encountering resident macrophages in the liver and spleen, the nanoparticle is again efficiently eliminated from the circulation by phagocytosis. Third, the nanoparticle may ride within the center of the advancing laminar flow column of blood in within the vasculature such that it does not contact the endothelial lining of tumor neovasculature to facilitate tumbling through the wide interendothelial fenestrations and pores that are the hallmark of leaky chaotic immature neoangiogenic blood vessels, the enablers of the EPR effect. Fourth, upon extravasating from the tumor vasculature, the nanoparticle faces a harsh tumor microenvironment that is not conducive for interactions with cancer cells. Not surprisingly, an appraisal of published reports of nanoparticle delivery to tumors concluded that on average only 0.7% of intravenously administered nanoparticles reach the tumor as a consequence of these pharmacokinetic impediments.[1] Yet, nanoparticles have shown promise in terms of minimizing systemic exposure to drugs and thus reducing toxicity of some chemotherapeutic agents.[2] Clearly, newer techniques are needed to improve tumor-specific delivery of nanoparticles to tumors and to subcellular compartments where they exert their therapeutic effects.

My talk will briefly outline a few strategies to overcome these barriers. These include the use of phagocytosis inhibitors,[3] changing the shape of particles,[4] making them stimulus-responsive,[5-6] and encapsulating them in Trojan-horse decoys.[7] Largely, they use gold nanoparticles as radiation sensitizers.

In a slight departure from this general theme of using nanoparticles to improve the effectiveness of radiotherapy, the final segment of my talk will touch upon the idea of using radiation therapy as a tool to make photodynamic therapy more accessible for deep-seated tumors where light cannot penetrate readily. Here, we have fashioned a novel X-ray excited Photodynamic Therapy (XPDT) approach wherein a scintillating nanoparticle is conjugated to a photosensitizing compound such that X-ray triggered emission of light from the nanoscintillator is absorbed by the photosensitizer to generate reactive oxygen species (ROS) leading to DNA and lipid membrane damage. Since clinically utilized ionizing radiation systems are non-invasive, deep-penetrating, and capable of image-guided stereotactic delivery of X-rays as part of the routine clinical pipeline, and the nanoscintillator-photosensitizer construct is administered intravenously, the XPDT approach is clinically achievable and has the potential to supplement or supplant conventional long-course radiotherapy and effectively reduce the radiation dose patients receive.

160 - EXPLOITING RADIATION-INDUCED TUMOR VULNERABILITIES VIA TARGETED ANTIBODY-DRUG CONJUGATES

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Gastric cancer is the fourth most lethal cancer globally, with an urgent demand for targeted therapy, as the survival rate for advanced-stage patients is 3%. We identified Heat Shock Proteins (HSPs), multifaceted endoplasmic reticulum proteins crucial to cancer proliferation, as potential targets. Previous attempts to target HSPs failed due to its intracellular localization. Our studies show a time

and dose-dependent radiation therapy (RT)-induced non-canonical upregulation of cell-surface HSP (csHSP) localization selectively in human (AGS) and murine (YTN16) gastric cancer cells but not benign human stomach epithelial GES1 cells via flow cytometry and immunofluorescence, thereby enabling the specific destruction of cancer cells using antibody-drug conjugates (ADCs). We demonstrated how ER-resident HSP shuttles to the membrane following RT via ER-trans-Golgi vesicular transport and is exocytosed via microvesicles in AGS and YTN16. As proof-of-concept, we used 10Gy RT with a commercial anti-HSP antibody conjugated to Auristatin E and showed a significant increase in AGS cancer cells apoptosis and decrease in overall viability (via Annexin V-PI staining and MTS assay) compared to individual treatment alone to demonstrate the efficacy. We also treated benign endothelial cells (HUVEC) with 10Gy RT+ADC and showed no decrease in live cells (Annexin V- PI- cells) compared to untreated group, suggesting our strategy's low off-target toxicity against healthy cells. We seek to optimize the efficacy of our strategy *in vivo* using syngeneic mouse models to develop a highly specific one-two punch combination therapy between RT+anti-HSP ADC for gastric cancer patients.

161 - INNOVATIVE HYDROGEL COMPOSITES TREATMENT AND NEURONAL ASSESSMENT FOLLOWING CRANIOFACIAL DEFECTS IN ADOLESCENT RATS

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Pediatric head trauma often results in serious outcomes, frequently requiring cranioplasty to reduce brain swelling, and is linked to long-term inflammation and memory deficits. The objective of the current study was to assess the healing and resorption rates of cranial defects with resorbable biopolymer composites, and evaluate the potential for inflammation-mediated changes in neurobehaviors and healing in juvenile rats. Five experimental groups using a 5-mm central critical-sized cranial defect model in Sprague-Dawley adolescent rats were included: (1) sham-operated, (2) empty defect, (3) placement of autologous bone, (4) composite with hydrogel composite, (5) placement of autologous bone and composite with hydrogel composite. Neurobehavioral assessment was performed biweekly, and characterization of bone remodeling performance was determined at the 8-week endpoint. Our results showed that the empty defect group decreased short-term memory in both male and female rats two, four, and six weeks after surgery, and had a higher effect on males. The autograft (bone placement) group exhibited decreased short-term memory for only two and four weeks, followed by recovery six weeks post-surgery, but not in the hydrogel composite group and the autograft plus hydrogel composite group. In addition, bone remodeling results, as determined by dual-energy X-ray absorptiometry (DEXA) scan, showed that the bone placement plus composite with hydrogel group achieved the most enhanced bone growth compared to composites lacking hydrogel eight weeks after surgery in both male and female rats. Our results suggest that the hydrogel composite, which enhanced bone repair and neurobehavioral performance, is superior to the autograft in our rat defect model.

162 - HIGH FREQUENCY ACOUSTIC MULTIPLE SCATTERING ANALYSES USING BOUNDARY INTEGRAL EQUATIONS

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Volume discretization methods face multiple challenges when used for exterior scattering analyses including high computational cost, need for artificial domain truncation and accurate boundary representation. These challenges are more pronounced in multiple scattering analyses where the wave moves back and forth between multiple obstacles. Conventionally such problems are solved by meshing the space between obstacles and truncating the domain with a fictitious boundary enclosing them. This makes mesh generation even more challenging and considerably limits the flexibility to move, rotate, and reshape the scatterers which are required for design and optimization of devices relying on wave propagation phenomena. Hence, spatial dimension reduction is highly desirable. Methods relying on boundary integral equations allow spatial dimension reduction, however, these methods introduce new challenges such as the need to treat singular integral kernels and lead to dense and possibly ill-conditioned matrices

limiting them to low- to mid-frequency analyses. Like boundary integral methods, On Surface Radiation Conditions (OSRC) require boundary discretization only and lead to integral equations with smooth kernels. We demonstrate possibility of enhancing the accuracy OSRC for single and multiple scattering analyses and adopt it to develop a well-conditioned method based on fundamental solution. These developments reduce the spatial dimensions by one as the interaction between scatterers are captured analytically; the need for treating singularities is eliminated; and reliable single and multiple scattering analyses can be performed for arbitrarily shaped scatteres in mid- to high-frequency regimes.

163 - A STUDENT-LED APPROACH TO BUILDING RESEARCH SKILLS EARLY IN MEDICAL EDUCATION THROUGH A MEDICAL STUDENT RESEARCH INTEREST GROUP

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Clinical research is essential to the advancement of medicine and the practice of evidence-based care. While physicians play a pivotal role in conducting clinical research, formalized training in research methodology is often lacking in medical education. Many medical students begin medical school with minimal exposure to research skills or structured training opportunities. A recent study found that only 37% of medical students felt adequately prepared to conduct a research project. Another study identified lack of research knowledge and skills as a key barrier to student research involvement, with only 14.4% of respondents disagreeing with that concern. As residency application competitiveness continues to increase, with rising expectations for research productivity, there is a clear need for accessible, skill-building opportunities for medical students. This pilot study serves a student-led, interest group-based approach to building research competency early in medical education. The goal is to develop and evaluate a series of practical, skill-focused workshops hosted through a medical student research interest group. The established curriculum includes a series of hands-on workshops covering topics such as IRB submissions, basic statistics, data extraction using EPIC electronic medical records, data filtering and management in Microsoft Excel, data analysis with R Studio, research presentation skills for conferences, using AI and machine learning in modern medicine, and additional relevant topics. Surveys are distributed to participants at baseline, prior to and after completion of each individual workshop, and upon completion of the workshop series. The survey assesses both objective markers (e.g., prior research experience, number of publications, and types of research conducted) and subjective outcomes (e.g., student self-confidence in performing specific research tasks using a Likert scale). Pre- and post-intervention data was compared to evaluate changes in student confidence and perceived research competency. We anticipate that participation in the workshop series will result in increased student confidence in core research skills and higher research productivity. In addition, student satisfaction and engagement with each workshop was analyzed to identify which topics were most impactful and which delivery methods were most effective. These insights will guide future iterations of the curriculum and allow for expansion into a larger student cohort potentially into the medical school curriculum. A student-led research interest group can serve as an effective platform for delivering foundational research training to medical students. This initiative has the potential to address a significant gap in medical education, enhance student research productivity, and foster early interest in academic medicine and clinical research careers.

164 - SUBSTITUTED PIPERIDINES (α4)3(β2)2 NICOTINIC ACETYLCHOLINE RECEPTOR POSITIVE ALLOSTERIC MODULATORS: IN-VIVO PHARMACOLOGY

Kwadwo Appiah-Poku[1], Nathalia Pinheiro Menegasso[1], Wilder Felix[2], Yushe Nazrul Islam[1], Adiam Michael[1], Nolawit Tilahun[1], Ganesh Thakur[2], Ayman Hamouda[1], Brent Bill[1]

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Parkinson's Disease (PD) is a neurodegenerative disorder characterized by motor dysfunction and other syndromic features caused by loss of M9 striatal dopaminergic (DA) neurons. Current treatments focus on increasing DA synthesis to mitigate symptoms, but they do not cure PD suggesting a need for alternative therapeutics. Nicotinic acetylcholine receptors (nAChR) are expressed on the striatal DA neurons; and activation leads to increases in dopamine concentration suggestion this as a potential druggable target. A neuroprotective effect has been hypothesized based on studies assessing the nAChR agonist, nicotine. Due to receptor promiscuity of nicotine as well as a lack of consistent results, receptor subunit specific drugs are being investigated. Positive allosteric modulators (PAM) of the (α4)3(β2)2 nAChR represent a new class of receptor specific drugs that increase the affinity for ACh thus increasing its activation potency. We hypothesize that these receptor specific PAMs will be able to increase dopamine release and provide additional neuroprotection thus mitigating PD symptomology. The

goal of this work was to perform an initial dosage and toxicological analysis for several PAMs that are chemical derivatives of CMPI (3-(2-chlorophenyl)-5-(5-methyl-1-(piperidin-4-yl)-1H-pyrrazol-4-yl) isoxazole) *in vivo*. Zebrafish are a common tool for performing drug screening due to their low cost, optical translucency, and shared homology within the acetylcholine system. Zebrafish were exposed to PAMs at 3- and 4-days post fertilization and larval viability and morphology were visually assessed at 6, 24, and 48 hours post initial exposure. PAMs were selected based on their ability to potentiate (α4)3(β2)2 nAChR with and EC_{50} <1 μM. Most PAMs were not toxic to zebrafish larvae at concentrations that potentiate (α4)3(β2)2 nAChR (EC_{50} <1 μM); however, at higher concentrations, larval toxicity was evident. Of the compounds assessed, A12c had the least cellular toxicity and no larval mortality up to 100 μM. This establishes that our PAMs are viable candidates to move forward into drug treatment studies within our zebrafish model.

165 - TREM-1: AN AMPLIFIER OF PLEURAL INFLAMMATION IN A RABBIT MODEL OF EMPYEMA

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Empyema is a severe pleural infection involving excessive inflammation, progressive tissue damage and purulent fluid buildup, ultimately advancing to fibrotic remodeling and pleural thickening. This escalating inflammatory process impairs lung expansion and function. Despite advances in treatment, the global incidence of empyema continues to rise, highlighting the need for a deeper understanding of the immune mechanisms that drive its progression.

The innate immune response- particularly involving neutrophils, monocytes/macrophages play an important role in driving pleural injury. Triggering Receptor Expressed on Myeloid Cells-1 (TREM-1) acts as an amplifier of inflammation. Soluble TREM-1 is being evaluated as a diagnostic and prognostic biomarker in septic patients, and TREM-1as a target for anti-inflammatory therapies in clinical trials. Empyema is a localized form of pleural sepsis, thus targeting TREM-1 may provide new strategies for modulating inflammation and improving outcomes in empyema.

In a *Streptococcus pneumoniae*-induced rabbit model of empyema, we observed elevated TREM-1 expression in neutrophils, monocyte/macrophages, mesothelial, and alveolar epithelial cells. Pleural fluid analysis showed increased levels of soluble TREM-1, IL-6, IL-8, TNF-α, and TGF-β, along with elevated neutrophil infiltration and total white blood cell counts, closely resembling human empyema. Furthermore, IL-6 and IL-8 levels showed a positive correlation with TREM-1 expression (r = 0.5201 and 0.1386, respectively) and strongly with each other (r = 0.7481), reinforcing its role in triggering inflammatory response.

We hypothesize that TREM-1 upregulation leads to inflammatory cascade in empyema and contributes to pleural tissue damage and fibrosis. Our rabbit model of empyema recapitulates human empyema and serves as a relevant preclinical model for evaluating TREM-1-targeted anti-inflammatory therapies.

166 - ELECTROSPUN CORE-SHELL MICROFIBERS FOR CONTROLLED DRUG DELIVERY AND CELLULAR ACTIVITIES

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Electrospun core-shell microfibers have demonstrated the ability in controlled drug delivery by encapsulating drugs in the core compartment with a protective shell layer. In this study, we report the effects of core/shell flowrate ratios and drug loadings from electrospun polycaprolactone (PCL) core/shell microfibers on the in vitro release behaviors of a model drug, ibuprofen (IBP). Core/shell PCL microfibers were electrospun using flowrate ratios of 1C/2S, 1C/4S, and 1C/8S with a total flowrate of 25 uL/min. Cumulative releases of IBP from various PCL core/shell microfibers loaded with 15% w/w IBP to PCL core were 96.5 ± 2.5%, 78.7 ± 0.9%, and 62.4 ± 2.3% for 1C/2S, 1C/4S, and 1C/8S microfibers, respectively, after 24 hours. To standardize drug loadings in microfibers, IBP loading was adjusted to 200 ug/mg (drugs/fibers). Cumulative releases of IBP were 99.3 ± 7.3%, 94.2 ± 3.5%, and 83.8 ± 10.2% for 1C/2S, 1C/4S, and 1C/8S microfibers, respectively, after 24 hours, suggesting drug loading minimally affected drug release from electrospun core-shell microfibers. In addition, cumulative releases of IBP decreased to 87.2 ± 6.1%, 76.5 ± 1.7%, and 45.4 ± 0.9% for 1C/2S, 1C/4S, and 1C/8S microfibers, respectively, after 24 hours when using a lower concentration of PCL core while maintaining the same drug loading (i.e., 200 ug/mg). This result suggested the interfacial effect of polymer solution mixing during coaxial electrospinning. Furthermore, NIH 3T3 cells viabilities showed that microfibers exhibited excellent cell biocompatibility after 24 hours. Our findings offer valuable insights to electrospun core-shell microfibers for drug delivery and tissue engineering applications.

167 - RECOVERING RARE EARTH ELEMENTS FROM BRINE WITH AMINO ACID-ANCHORED TWO-DIMENSIONAL MATERIALS

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Rare earth elements (REEs) are critical for advanced technology sectors. It is important to build domestic production capability to ensure supply. REEs commonly exist in various brine sources but with very low concentration, typically ppb to ppm level. Highly selective adsorption is a desirable solution for recovering REEs from brines. Peptides with sophisticatedly designed structures have demonstrated high REE adsorption uptake and exceptional selectivity over competing metal ions. However, the sophisticated structures for the peptides lead to expensive sorbents and low process economic viability. In this work, we discuss the possibility of applying cheap amino acid-containing two-dimensional (2D) materials for REEs recovery. 2D materials have the advantage of a high specific surface area, which is also highly accessible. With rich surficial amino and carboxyl functional groups like peptides, the amino acid-containing 2D materials could potentially achieve high selectivity towards REEs if the microstructure is tuned properly. In our preliminary work, the 2D materials achieved excellent REE adsorption selectivity over monovalent metal ions, good selectivity over bivalent metal ions and moderate selectivity towards trivalent metal ions. A few different amino acids have been incorporated into the 2D materials. Detailed characterization of their physical and chemical properties is conducted to understand the influence from the microstructure and chemistry of the 2D materials on their metal ion adsorption properties.

168 - DEVELOPING AND EVALUATING A PILOT AUGMENTED INTELLIGENCE FOUNDATIONS CURRICULUM FOR MEDICAL STUDENTS

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As augmented intelligence (AI) becomes increasingly embedded in clinical practice, it becomes imperative to equip medical students with the foundational knowledge and practical skillset required to employ these auxiliary tools safely, ethically, and effectively in patient care. Current AI educational programs for medical students utilize multi-pronged strategies that combine didactic presentations with practical application training. These include lectures on core concepts such as machine learning, data science, and evaluation metrics coupled with interactive modules involving case studies, simulations, and collaborative projects. However, without a uniform curriculum or assessment strategy, most implementations of AI education remain inconsistent and highly variable.

This pilot study was designed to evaluate a short-format AI curriculum tailored to both preclinical and clinical medical students. The curriculum aligned with emerging best practices by integrating online asynchronous content, interviews with content experts, and case-based simulations. The educational content targeted four key AI competency domains: foundational understanding and limitations, clinical applications, interpretation of outputs, and ethical considerations.

To assess the efficacy of our curriculum, we utilized a pre- and post-education evaluation, as well as application-based questions embedded within the presentation to ascertain objective measures. Subjective measures were obtained through a survey containing validated scales assessing interest, confidence, and perceived readiness to use AI both during their medical education and in clinical practice. Outcomes will be analyzed separately for preclinical and clinical learners to identify trends stratified by stage of medical training. Although outcome data are still being analyzed, we anticipate that the curriculum will yield significant gains across all targeted AI competency domains.

This study is expected to serve as a scalable model for AI literacy in medical education and contribute to ongoing efforts to standardize AI education in health professions training. Additionally, future implications of this study may establish a framework for evaluating AI education using both cognitive and affective metrics.

169 - STATE-LEVEL INEQUITIES AND REGIONAL VARIATION IN NEURAXIAL PAIN MANAGEMENT DURING LABOR IN THE UNITED STATES

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Background: While neuraxial labor analgesia is considered the preferred method for pain relief during childbirth and its use varies across different populations. Previous research identified maternal age, race, insurance type, education, marital status, body mass index, medical conditions, prenatal care, gestational age, and birth attendants as key influences, focusing on the mother's characteristics. Additional characteristics, including paternal factors, insurance type, and socioeconomic status, warrant further investigation to confirm their distinct

contributions. **Objective:** This study aims to reexamine the previously identified factors from US birth certificate data over the span of 2015 to 2023 and explore novel contributing factors influencing the utilization of neuraxial analgesia. **Methods**: This study included women who experienced labor before vaginal or intrapartum cesarean delivery and excluded non-U.S. residents, out-of-hospital births, multiple pregnancies, and planned cesarean deliveries, combined with state-level measures on the anesthesia workforce. To analyze state-level variability in neuraxial analgesia usage, the Intraclass Correlation Coefficient (ICC) and Median Odds Ratio (MOR) were employed. We examined clustering patterns of neuraxial analgesia at multiple levels, visualized percentage differences, and applied multilevel logistic regression to determine adjusted odds ratios (OR) with 95% confidence intervals (CI) for within-group comparisons. Quantile G-Computation (QGC) and Bayesian Kernel Machine Regression (BKMR) were used for combined effects analysis.

Results & Conclusion: The utilization of neuraxial labor analgesia varied across all factors examined. ICC and MOR indicated a low state-level variation. Significant differences in CI were observed across all the above factors. Longitudinal analysis revealed consistent increasing trends for most of the variables over the nine years, except the number of anesthesia workers. Novel factors examined and associated with the use included the time of birth, the father's race and education, and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) participation. While WIC status, as a proxy for family income, was identified as a factor, its significance was less pronounced than insurance coverage. Although individuals who qualify for Medicaid are more likely to qualify for WIC, our analysis revealed that WIC participation acted as a confounder. Within each insurance category, the prevalence of neuraxial analgesia differed significantly based on WIC enrollment, indicating the effect modification. Notably, in CA and AK, the WIC factor had a bigger impact on neuraxial analgesia usage compared to the insurance factor. QGC and BKMR analyses suggested the presence of combined effects among these factors.

170 - ADVANCED SELECTIVE KINASE INHIBITORS FOR ENHANCED TREATMENT OF CNS METASTASES OF BREAST CANCER

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Introduction: Central nervous system (CNS) metastases markedly deteriorate prognoses in patients with HER2-positive and triple-negative breast cancer (TNBC). Effective systemic therapy is impeded by the restrictive properties of the blood-brain barrier (BBB), which inhibits numerous therapeutic drugs from attaining clinically effective concentrations in brain tissue. Current HER2 inhibitors do not sufficiently penetrate the BBB, restricting their CNS effectiveness against metastatic lesions. **Rationale**: Due to the limited effectiveness of existing HER2-targeted medicines in treating brain metastases, there is always an urgent need for novel kinase inhibitors, particularly designed to improve BBB permeability and selective inhibition of HER2 as a potential target of metastatic BC cells. The structural optimization of current kinase inhibitors presents a logical approach to attaining successful CNS-targeted therapy. **Methods**: Employing structure-based drug design, we synthesized novel small-molecule analogs tailored for BBB penetration. Thorough in silico modeling, in vitro screening encompassed anticancer cytotoxicity, selectivity profiling against, and enzymatic inhibition. Moreover, BBB permeability was quantitatively evaluated by parallel artificial membrane permeability (PAMPA) experiments and estimates of the brain-to-plasma partition coefficient (pLogBB). **Results**: The synthesized analogs, particularly **HA-149**, **HA-153**, and **HA-157**, exhibited remarkable enhancement in HER2 inhibition, displaying nanomolar potencies and considerable selectivity towards off-target kinases. Compound **HA-149** demonstrated significant favorable BBB permeability based on PAMPA tests (Pe = 73 nm/s) compared to carbamazepine (Pe = 67.1 nm/s), underscoring its therapeutic potential. Compounds HA-153 and HA-157 exhibited notable selectivity towards breast cancer cells, with a particularly pronounced effect against triple-negative breast cancer (TNBC) cell lines. Among them, HA-157 demonstrated promising Multikinase inhibitory activity, achieving percentage inhibition values of 96% for EGFR, 68% for HER2, 82% for HER4, and 60% for KDR at a concentration of 10 μM. **Conclusion**: This work highlights the viability and efficacy of structurally tailored kinase inhibitors in surmounting the blood-brain barrier in breast cancer brain metastases. The identified lead compounds, especially HA-149, HA-153, and HA-157, are intriguing candidates for CNS-targeted breast cancer therapy, necessitating further in vivo assessment and pharmacokinetic studies to facilitate clinical translation.

171 - AN UNBIASED COMPUTATIONAL ANALYSIS OF CRISPR/Cas9 OFF-TARGET EFFECT

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Background: The CRISPR/Cas9 system is a powerful tool for genome editing, but accurately identifying off-target effects remains a major challenge. Most tools analyze sequence homology to the on-target site assuming the cleavage location is related to sgRNA and protospacer adjacent motif (PAM). Some quantify it as cleavage scores, however, the cleavage scores alone often underestimate these biological facts such as PAM flexibility, DNA physical properties, and RNA secondary structure and folding dynamics. Whole-genome sequencing (WGS) offers an unbiased way to detect CRISPR-induced cleavage events directly from DNA. In WGS data, sudden drops or walls in aligned read coverage can be identified as double-strand breaks (DSBs) and homology-directed repair (HDR) events. Additionally, current methods often require wet-lab confirmation and fail to assess the efficiencies of HDR and non-homologous end joining (NHEJ). To address these limitations, we developed a computational pipeline for unbiased genome-wide detection of CRISPR/Cas9-induced cleavage events in *Plasmodium falciparum* WGS data. Our pipeline includes unmatched reads, visualizes editing outcomes, and provides predictive insights to minimize off-target effects more proactively. **Methods**: Standard Burrows-Wheeler Aligner (BWA) for general genomic analyses often leaves certain parameters undefined to facilitate the exploration of genetic variations and divergence across genomes or samples. In contrast, our strategy employed more stringent BWA parameters, including higher mapping quality requirements, stricter clipping thresholds, and a lower tolerance for mismatches. This approach ensured that well-aligned reads were retained in a primary Sequence Alignment Map (SAM) file, while those reads exhibiting on-target or off-target activity were saved in a secondary SAM file. pysam library was used to extract the start and end positions of reads from both the primary and secondary SAM files. A “clipped” label was added for those reads with partial matched followed by unmatched sequence. Based on this, the cleavage locations were calculated by Concise Idiosyncratic Gapped Alignment Report (CIGAR) strings. Soft-clipping (S) and hard-clipping (H) are used to identify the sites of HDR and NHEJ repair. The coverage pattern of the starts, ends, and clipped points was used for on-target and off-target analysis. **Results:** Baseline coverage was determined for each gene. Examination of CIGAR strings to extract soft-clipped and hard-clipped bases in secondary reads allowed for the detection of HDR or editing events. The DSBs without repair generated a drop pattern in the primary read. Combining the ends and clipping points, the manifest of a narrow peak in proximity to a reduced ends coverage identified CRISPR/Cas9 cleavage sites. These sharp peaks were typically confined to a small number of nucleotides, in contrast to broader or irregular accumulations, which likely represented non-specific cleavage. **Conclusions:** Large insertions resulting from HDR frequently caused lower alignment scores, leading to these reads being categorized as secondary alignments. These events generated characteristic wall-like patterns in sequencing coverage. Conversely, unrepaired DSBs, producing shorter DNA fragments, were prone to ligation with multiple adapters or to being undetected or filtered out during sequencing, resulting in localized drops in coverage. Analysis of soft and hard clipping aided in distinguishing these alterations: HDR events manifested as clipped reads within the secondary reads, whereas NHEJ signatures were linked to soft-clipped in the primary read. However, increases in coverage attributable to NHEJ were often minor and challenging to differentiate from background noise. Our computational pipeline provides a stringent, reference-based approach for identifying both on-target and off-target CRISPR/Cas9 activity, without requiring prior knowledge of sgRNA sequences or potential target sites. **Limitations:** Some noise remains inherent, such as soft clipping from natural genomic variation or DSBs induced by cellular stress. The predictions made without identified sgRNA sequences and PAM motifs necessitate

172 - BRIDGING THE GAP: ENHANCING MEDICAL STUDENT UNDERSTANDING OF EEG THROUGH INTERACTIVE, TECHNOLOGY-DRIVEN MODULES

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Introduction: Despite its central role in diagnosing and managing neurological conditions, electroencephalography (EEG) remains underemphasized in many medical school curricula. Studies have shown that graduating medical students and even early neurology residents often report low confidence in EEG interpretation. This educational gap is particularly concerning given EEG's expanding applications beyond epilepsy, including sleep physiology, movement disorder evaluation, and intraoperative neurophysiological monitoring. Quantitative EEG (QEEG) which applies mathematical and statistical techniques to analyze brainwave activity, is also becoming increasingly relevant. It offers objective insights that complement traditional EEG interpretation and is used in areas such as neuropsychiatric assessment, brain injury evaluation, and neurofeedback therapy. As technologies like deep brain stimulation and brain-computer interfaces continue to advance, developing competence in both standard and quantitative EEG methods is essential. Bridging this gap in education will better prepare future physicians to engage

with modern neurodiagnostic tools and contribute meaningfully to evolving neuroscience and clinical practice. **Methods:** A cohort medical students participated in an educational program that included visual EEG simulations, clinical vignettes, and self-assessment quizzes. Pre- and post-module surveys and knowledge tests were administered to assess changes in confidence and competence. **Results:** We anticipate that a significant improvement in both objective EEG interpretation scores and subjective comfort levels. Students particularly valued the integration of real EEG tracings with clinical cases. **Conclusion:** Incorporating technology-enhanced learning tools into medical curricula can bridge critical gaps in EEG education, better preparing future physicians to interface with neurodiagnostic tools. This study highlights the potential of biomedical engineering innovations in transforming medical education.

173 - THERMO-CATALYTIC APPROACHES FOR THE CONVERSION OF BIOMASS INTO HYDROCARBONS

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The conversion of lignocellulosic biomass into hydrocarbons has been a major research goal for many years, as it may provide a path to generate liquid transportation fuels from agricultural residues and other types of waste material. A number of methods have been employed to achieve this goal, and the limitations often prove to be of economic nature.

This talk will discuss a variety of thermo-catalytic approaches for the conversion of biomass into hydrocarbons. In particular, we will describe results involving methods that can potentially generate high-value chemicals from biomass, as these have a much higher chance to lead to economically viable processes. These methods may involve homogeneous or heterogeneous catalysts, hydrogen gas, or hot compressed water. We will discuss results obtained for catalytic fast pyrolysis, hydropyrolysis, and hydrothermal liquefaction. We will also discuss thermo-catalytic methods that serve as important steps for commercially important processes, such as the oligomerization of ethylene, which plays an important role in the alcohol-to-jet process. We will discuss strengths and weaknesses associated with each technology, and the types of products that can be obtained with each.

174 - DISCOVERY OF POTENT ANTICANCER KINASE INHIBITORS VIA INTEGRATED IN VITRO AND IN VIVO SCREENING

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Background: Kinase inhibitors have revolutionized cancer therapy by targeting specific dysregulated cellular pathways. Despite the introduction of several kinase inhibitors, novel kinase inhibitors are still needed to overcome resistance and improve therapeutic outcomes. This study aimed to identify potential lead compounds from an in-house library of kinase inhibitors and explore their mechanism of action by *in vitro*, *in vivo*, and *in silico* studies. **Methods:** The screening started with evaluating the potential anticancer activity of the compounds against NCI 60 cell lines of nine different cancer types. The potential compounds showing promising results were subjected to *in silico* molecular docking and *in vitro* kinase profiling to evaluate their inhibitory potential against selected kinases. The most promising compound was used for an in vivo study, where its ability to prevent cancer progression was assessed in a mouse model. **Results:** Among the compounds, more than 50 compounds showed >50% average growth inhibition at 10 μM concentration against 60 cell lines. Some of them showed significant selectivity against specific cell lines, with GI_{50} values in the nanomolar range, while a few showed significant growth inhibition against almost all the cell lines. Compounds HA45 and HA46 showed good activity against breast cancer cells. Compounds HA9,10,12 and 23 showed high selectivity against LOX-IMVI and Sk-MEI-5 melanoma cell lines. Compound HA88-97 showed a very high level of non-selective growth inhibition. Compound HA57-58 showed selective growth inhibition against the MDA-MB-468 cell line. HER2, KDR, c-KIT, were the major kinases inhibited by these compounds. In an *in vivo* study, compound HA46 showed a significant reduction in tumor growth without any severe adverse effects. **Conclusions:** This comprehensive screening led to the identification of several compounds with potent and selective anticancer activity across a wide range of cancer cell lines. The inhibition of key kinases indicates a viable mechanism of action and supports further development of these compounds as promising candidates for targeted cancer therapy.

175 - IN VITRO EVALUATION OF PAI-1 NEUTRALIZATION BY NOVEL GLP-FRIENDLY PEPTIDES IN RABBIT AND HUMAN MESOTHELIAL CELLS

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Empyema, a serious complication of pneumonia marked by the accumulation of purulent fluid in the pleural space, has been increasing in prevalence both in the U.S. and globally. Intrapleural fibrinolytic therapy (IPFT) is commonly used to treat empyema by promoting the resolution of pleural injury. However, the efficacy of IPFT is limited by plasminogen activator inhibitor-1 (PAI-1), a major inhibitor of tissue-type (tPA) and urokinase-type (uPA) plasminogen activators, which is overexpressed by 1000-fold in empyema pleural fluid. Previous studies have shown that neutralizing PAI-1 with monoclonal antibodies (mAbs) enhances the effectiveness of IPFT in two different animal models. This study aimed to evaluate the potential of novel GLP-friendly peptides 1&2 to neutralize PAI-1 in mesothelial cells. Primary rabbit pleural mesothelial cells (RPMC) and the human mesothelial cell line (Met5A) were stimulated with TGF-β and treated with the peptides. Analysis of conditioned media and cell lysates showed significant reduction in PAI-1 and α-SMA protein levels in both cell types. Immunofluorescence further confirmed decreased expression of these markers. Additionally, gene expression analysis revealed downregulation of SERPINE1 (PAI-1) and ACTA2 (α-SMA) in RPMC, and reduced SERPINE1 expression in Met5A cells. Importantly, LDH assays confirmed that GLP-friendly peptides 1&2 were non-toxic to mesothelial cells. These results showed that the peptides effectively neutralize PAI-1, like mAbs, in mesothelial cells and may contribute to improving cost and efficacy PAI-1 targeted empyema therapy.

176 - MORPHOLOGICAL ANALYSIS OF ARIP CELLS FOLLOWING GLUCAGON-LIKE PEPTIDE-1 EXPOSURE

Gary Hamil[1, 2], Hamed Benghuzzi[3], Michelle Tucci[2], Kenneth Butler[2]

[1]Belhaven University, Jackson, MS, [2]University of Mississippi Medical Center, Jackson, MS, [3]Jackson State University, Jackson, MS

Introduction: Previous research in our laboratory has shown that tricalcium phosphate lysine (TCPL) bioceramic reservoirs loaded with PANC1 and ARIP cells demonstrate a promising ability to adjust insulin production in response to glucose challenges. We observed that insulin levels increased and glucose levels decreased significantly after 48 hours of exposure to glucagon-like peptide-1 (GLP-1). Treatment with 10nM GLP-1 did not affect cellular viability or proliferation. However, there is limited data on the morphology of ARIP cells exposed to varying glucose levels and the impact of GLP-1 inhibitors on their morphology. **Methods:** Cytomorphological data of ARIP cells were collected at 24, 48, and 72 hours. Various statistical methods were used for analysis, including parametric statistics for continuous data (ANOVA with post hoc Bonferroni LSD) and non-parametric statistics (Kruskal-Wallis H) for nominal or categorical variables, with $\alpha=0.05$ for all analyses. **Results:** The investigation revealed statistically significant differences between control and experimental groups using ANOVA and Kruskal-Wallis tests. ANOVA results showed significant differences in the number of cells per high power field (HPF), nuclear, and cell area, as indicated by the N/C ratio ($p<0.05$). No significant differences were found in cell count or nucleoli presence. Moderate to strong effect sizes suggested that the differences were both statistically and practically significant. The Kruskal-Wallis H test confirmed significant differences in the distribution of ranks across groups for N/C ratio (qualitative), cellular density, proliferation, cellular appearance, cell shape, nuclear shape, nuclear border, binucleation, spindle-shaped, round-shaped, cuboidal or epithelioid, pyknosis, chromatin pattern, and aggregation in clusters or sheets ($p < 0.05$). These findings indicate that GLP-1 treatment significantly affected insulin and glucose levels and cell morphology at 24, 48, and 72 hours, warranting post-hoc analyses to identify specific group-level differences. The results provide strong evidence of variability between groups, highlighting the importance of using both parametric and non-parametric approaches in comprehensive data analysis. **Conclusions:** This study builds on previous research demonstrating the adaptability and potential of ARIP cells for use in TCPL bioceramic reservoirs to regulate insulin production in response to physiological glucose challenges. While earlier studies emphasized GLP-1's role in enhancing insulin secretion without affecting cellular viability and proliferation, our findings expand this understanding by providing critical insights into the cytomorphological changes in ARIP cells exposed to varying glucose levels and GLP-1 treatments. This study advances our knowledge of ARIP cell responses to glucose and GLP-1, underscoring the potential for further exploration of ARIP cells with GLP-1 to optimize therapeutic strategies in bioceramic cell-based systems for diabetes treatment.

177 - EXOSOMES AS PRECISION TOOLS FOR THE NEXT ERA OF REGENERATIVE AND DIAGNOSTIC MEDICINE" (SUBTITLE: FROM NEUROLOGICAL REPAIR TO LIQUID BIOPSY - A TRANSLATIONAL JOURNEY)

Dongki Kim

ExoTop Theragnostics Inc, College Station, TX

In the rapidly evolving landscape of biomedical engineering, exosomes have emerged as transformative

nano-scale communicators with the ability to revolutionize diagnostics, therapeutics, and targeted drug delivery. This keynote will explore how ExoTop Theragnostics Inc., based at the Texas A&M Institute for Preclinical Studies, is harnessing the inherent biological intelligence of exosomes—cell-derived extracellular vesicles—to overcome the limitations of conventional therapies in treating complex diseases such as neurodegeneration, autoimmune disorders, and chronic inflammation. This talk will present a comprehensive overview of: **Therapeutic applications**, including preclinical studies targeting spinal cord injury, hair regeneration, and neuroinflammation through intranasally administered MSC-derived exosomes. **Exosome-based liquid biopsies**, particularly the development of non-invasive urinary diagnostics for early cancer detection and disease monitoring. **Next-generation drug delivery systems**, using customized exosome formulations to cross challenging barriers like the blood-brain barrier, enabling minimally invasive and patient-specific treatments.**Scalable biomanufacturing innovations** that ensure quality-controlled, GMP-aligned production for both therapeutic and diagnostic applications. With projected compound annual growth rates (CAGR) exceeding 25% across the exosome therapeutics and diagnostics markets, and recent clinical momentum in exosome-based interventions, this presentation will argue that exosomes are not merely an alternative platform—but a paradigm shift in biomedical science. Finally, the talk will conclude by outlining the path from **bench to bedside**, emphasizing the pivotal role of cross-disciplinary collaboration between molecular biology, clinical science, and bioengineering in ushering in this new era of precision medicine.

178 - A LABORATORY MODULE FOR DIFFERENTIATING ABSORPTION, SCATTERING, AND FLUORESCENCE IN UV-VIS SPECTROSCOPY

Christopher Jurgenson[1], Dongmao Zhang[2], Pathum Wathudura[2], Huy Pham[2]

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UV-Vis spectrophotometry is a core analytical tool in biomedical engineering, prized for its simplicity, versatility, and reproducibility. Yet, accurate interpretation of spectral data becomes challenging when light attenuation arises from a combination of absorption, scattering, and fluorescence—processes that violate the core assumptions of the Beer-Lambert Law and compromise quantitative accuracy.

To address these complexities, we developed a laboratory module featuring model systems that isolate each phenomenon: potassium permanganate as a pure absorber, spherical polystyrene nanoparticles as scatterers, and Rhodamine B as a fluorescent probe. This hands-on module enables students to observe how each process uniquely alters UV-Vis spectra and to identify deviations from ideal Beer-Lambert behavior.

Implemented in a sophomore-level organic chemistry laboratory course, the module was assessed using pre- and post-surveys to measure learning gains. Students engaged with both theoretical frameworks and experimental data, developing critical skills in the interpretation of non-ideal spectral profiles.

This educational approach emphasizes the limitations of the Beer-Lambert Law under real-world conditions—such as non-negligible scattering, fluorescence overlap, and non-linear concentration effects. By equipping students with tools to recognize and account for these deviations, the module fosters a deeper understanding of light-matter interactions and strengthens problem-solving skills essential for applications in biosensing, imaging, phototherapy, and nanomaterial characterization.

179 - THE JACKSON HEART STUDY UNDERGRADUATE TRAINING AND EDUCATION CENTER: A 25 YEAR SUCCESS STORY

Wendy White, Kisa Harris, Amel Mohamed

Tougaloo College, Tougaloo, MS

The Jackson Heart Study (JHS) is a longitudinal study that is a scientific collaboration between Jackson State University, Tougaloo College, Mississippi State Department of Health, and the University of Mississippi Medical Center. The cohort was selected from three counties in central Mississippi: Hinds, Madison and Rankin counties. Even though the primary objective of the Jackson Heart Study is to investigate the causes of cardiovascular disease (CVD) in African Americans, one of the missions of the JHS is to build research capabilities in minority institutions at the undergraduate and graduate level by developing partnerships between minority and majority institutions and enhancing participation of minority investigators in large-scale epidemiologic studies.

The JHS TECs have designed numerous pathways to careers in public health, engaging students in experiences to create interest in public health, research, and health-related careers. JHS initiated a Training and Education Center (TEC) for undergraduate students on the campus of Tougaloo College and later instituted TEC programs for graduate students at Jackson State University (JSU) and the University of Mississippi Medical Center (UMMC). The TECs have built capacity and enhanced minority participation in public health and research, which has

resulted in the advancement of numerous professionals into the public health/medical arena.

In the 25 years since it started, the JHS Undergraduate Training and Education Center (UTEC) has supported over 300 undergraduate students. Many of the UTEC alumni enroll in graduate and/or professional schools after completing the program.

This presentation will detail the design of the program and share student outcomes.

180 - UNDERSTANDING PATHOLOGICAL VALVULAR DEGENERATION IN BICUSPID AORTIC VALVES

Carla Lacerda

The University of Texas at Tyler, Tyler, TX

Bicuspid aortic valve (BAV) is the most prevalent congenital human heart defect occurring in over 1% of live births with a three-fold higher rate in males than females, with a significantly understudied heritable component and a range of different leaflet fusions. The clinical presentation, morphology, and hemodynamic severity of BAV are highly variable making the clinical management of patients, who can present with symptoms at different ages, difficult. Because BAV leaflet fusions vary, it is believed that different flow patterns into the aorta lead to different clinical outcomes. To discriminate the genetic and hemodynamic components of progressive degenerative changes in BAV, our research group is studying tissues from humans and mouse models with BAV.

As a starting point, preliminary *data are needed on the transcriptomic differences between normal and bicuspid mouse aortic valves and their changes with age*. The transcriptomes acquired in this pilot project will shed new light into sex differences and may help elucidate why BAV degeneration is more prevalent in males. Our overall hypothesis is that, despite the common genetic background present in knockout mice, cardiovascular aging of aortic valves will result in transcriptional changes during progressive valve degeneration. We also expect that variable hemodynamic changes will be associated with variable remodeling, i.e., aortic valve cusp degeneration with or without fibrosis or calcification, which is the basis of the proposed investigation. 25-30% of $eNOS^{-/-}$ mice present BAV, with left-noncoronary cusp fusions, the most common defect and with highest risk of stenosis and calcification later in life. Based on these observations of BAV prevalence in $eNOS^{-/-}$ mice, we are making comparisons of mice with and without BAV, male and female BAV incidence, as well as progression of degenerative changes over a period of 22 weeks, i.e., time to take young mice to middle age. Using this experimental approach and tricuspid aortic valve controls, we successfully verified that $eNOS^{-/-}$ mice present structural remodeling, as well as different severity levels induced by age and sex differences.

181 - MORE ACCURATE PREDICTION OF PM 2.5 FROM MODIS SATELLITE USING TOP-OF-ATMOSPHERE REFLECTANCE

Mridula Mavuri[1], Subhajit Chakrabarty[1], Devesh Sarda[1], Udaysinh Rathod[1], Tirthankar Chakraborty[2]

[1]Louisiana State University Shreveport, Shreveport, LA, [2]Pacific Northwest National Laboratory, Richland, WA

Understanding ground-level particulate matter concentrations accurately is fundamental to mitigating health risks and improving air quality. Traditional ground-based monitoring systems, such as those operated by the United States Environmental Protection Agency (EPA), provide precise $PM_{2.5}$ measurements but are limited by their sparse geographic distribution. The MODIS (Moderate Resolution Imaging Spectroradiometer) is a key instrument on the NASA Terra satellite that views the entire Earth's surface every 1 to 2 days, capturing data in 36 spectral bands. The most common method of estimating $PM_{2.5}$ uses Aerosol Optical Depth (AOD) from satellite, even though AOD itself is derived from Top-Of-Atmosphere Reflectance (TOAR). Our initial findings have shown that surface reflectance, a by-product of deriving AOD, remains predictive of ground-based $PM_{2.5}$—suggesting potential retrieval biases in AOD algorithms. Therefore, there is a case for bypassing AOD by using TOAR directly. However, only two studies (Shen et al., 2017; Yang et al., 2019) have explored TOAR-based $PM_{2.5}$ prediction with MODIS data, to date. This study examines TOAR's predictive power in depth, leveraging EPA measurements for ground truth.

Our dataset comprised daily Level-1B TOAR reflectance from the MODIS/Terra satellite (MOD021KM) for 2023. Reflectance values were co-located with EPA ground-monitoring stations via nearest-neighbor aggregation within a 1 km radius. Co-registered meteorological variables—including surface air temperature, relative humidity, 10 m wind speed components, and surface pressure—were sourced from the ERA5 reanalysis. Rigorous preprocessing applied cloud screening via MODIS QA flags, and exclusion of flagged or extreme outliers. Observation geometry parameters (solar zenith and sensor view angles) were incorporated to account for anisotropic reflectance patterns. A dynamic panel regression model with station-specific fixed effects and autoregressive $PM_{2.5}$ terms was calibrated for TOAR inputs.

Previous TOAR-based efforts plateaued at an out-of-sample R^2 of 0.87, indicating solid but limited explanatory power. Our model elevates this metric to 0.92. This improvement highlights our approach's enhanced accuracy in capturing $PM_{2.5}$ variability.

This work is significant because it demonstrates that first-principles TOAR inputs can rival or exceed more processed products for $PM_{2.5}$ estimation, streamlining the satellite-to-air quality workflow. By bypassing AOD retrieval algorithms—which can introduce biases, latency, and additional computational cost—the TOAR-based approach reduces preprocessing complexity, enhances near-real-time applicability, and expands spatial coverage. These findings support the development of efficient, globally scalable $PM_{2.5}$ mapping systems, particularly in regions lacking dense ground instrumentation.

182 - TARGETED DELIVERY OF THERAPEUTIC PROTEINS

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Osteoporosis gradually reduces bone density due to an imbalance between bone formation and breakdown. Effective and safe treatment requires delivering drugs directly to bones. Previous research used peptides binding to hydroxyapatite, a bone mineral, for this purpose. In this study, a hydroxyapatite binding (HAB) tag was added to 30Kc19α-Runt-related transcription factor 2 (RUNX2) to target bones. This modified protein can enter human mesenchymal stem cell (hMSC) nuclei, acting as a key regulator for bone formation. The HAB tag enhances RUNX2's affinity for mineral deposits in mature bone cells and tissue without affecting its bone growth induction capability. In a mouse model of osteoporosis, intravenous HAB-30Kc19α-RUNX2 injection led to its accumulation in the femur, promoting bone formation and reducing spleen toxicity. These findings highlight HAB-30Kc19α-RUNX2 as a promising candidate for targeted osteoporosis therapy.

183 - USE OF AN GLUCAGON-LIKE PEPTIDE 2 (GLP-2) COATED INTESTINAL EXPANSION SLEEVE (IES) TO LENGTHEN BOWEL

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[1]Department of Surgery, LSU Health Shreveport, LA, [2]Department of Molecular and Cellular Physiology, LSU Health Shreveport, LA

Background. Short bowel syndrome (SBS) is a common cause of intestinal malabsorption and malnutrition, which can be improved by natural adaptation along with either medical and/or surgical management. In a previous experiment, our lab has successfully demonstrated the use of an Intestinal Expansion Sleeve (IES) results in significant intestinal expansion via distraction enterogenesis in a live rat model. Other studies have attempted to treat SBS using Glucagon-like Peptide 2 (GLP-2) with great success. In rat models, GLP-2 has been shown to increase the weight, DNA content, and protein content within the bowel as well as increase the height of the microvilli present which led to more surface area for nutrient absorption (2,3). Additionally, our lab has identified a method to bind peptide molecules, such as GLP-2, to an IES using polyvinyl alcohol (PVA) (1). In this experiment, we utilized this technique to covalently bind GLP-2 to our IES devices in hopes of improving the healing and function of the intestinal mucosa while undergoing distraction enterogenesis. **Methods:** Each IES is a cylindrical device coated with a sealant on each end to prevent dysfunction when contracted that is cut to 3 cm and precontracted over a rigid polymer support. Each IES was coated with polyvinyl alcohol to which GLP-2 was bound as described by Colvin et al (1). A Roux-en-Y is created in the jejunum of the Sprague-Dawley rats to create an isolated area for deployment and reexpansion of the IES device. The IES device was placed into the isolated intestinal limb created by the Roux-en-Y procedure and permanently fixed using 4-0 silk permanent suture. Post-operatively, rats were rounded on daily examination and weighing. After 4 weeks time for expansion, rats were sacrificed and final measurements of the Roux limb were taken before being sent for histologic examination. **Results:** Previous in vivo IES experiments have shown a 30.2% elongation in Roux-en-Y length after 1 month of deployment but histologically showed mucosal sloughing and increased fibrosis. With the addition of GLP-2, the IES devices maintain the distractive capabilities and we anticipate improved mucosal healing and decreased fibrosis following expansion with the GLP-2 IES device. **Discussion:** The full analysis of the addition of GLP-2 to the IES devices are pending, however, we anticipate that this addition will help improve the regenerative and reparative capacity of the intestinal tissue to augment the significant intestinal

184 - AN EXPERIMENTAL INVESTIGATION OF THE DERMABOND EFFECT ON KNOT STRENGTH

Morgan Brown

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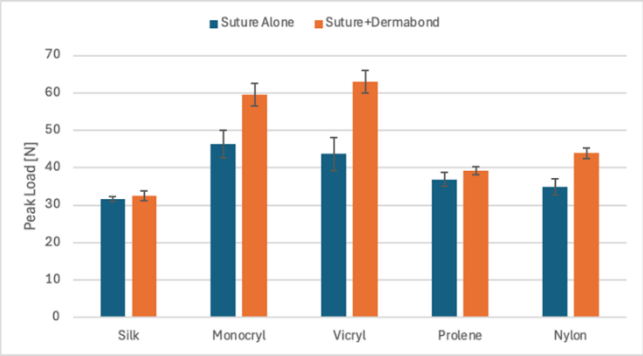
Background: Wound closure integrity is an important factor of the healing process. The strength of closure needed may vary depending on location of the wound: areas of high flexion/tension (i.e. the knee) may require a stronger closure than a more static area (i.e. forearm). Maximizing

wound closure strength in such areas of higher tension is critical to successfully coapting the wound edges to allow healing and prevent adverse outcomes such as infection and dehiscence. Dermabond is frequently used by physicians as an occlusive dressing because of its many protective qualities such as being strong, antimicrobial, flexible, and waterproof. There is limited research, however, into the effect of Dermabond on the strength of wound closures when used in combination with sutures. This strength enhancement knowledge could be especially significant to the integrity of wound closures on high tension areas such as joints. In this study, we hypothesize that Dermabond will



strengthen skin wound closures via strengthening the sutures used. **Methods:** Five different types of sutures were tested with and without Dermabond: Silk, Monocryl, Nylon, Prolene, and Vicryl (all 3-0). The sutures were tied in loops of 94.2 mm with a square knot at the base followed by an additional 4 regular knots for reinforcement. Dermabond was applied to the sutures via a small drop on the knot itself. Each suture had knot failure load testing using an Instron 8874 Biaxial Servo Hydraulic Fatigue System at a displacement rate of 5mm/min. There were 8 repetitions performed for each group, and testing was held over a 7-day period to evaluate any change in results over that time for a total of 80 experiments. Strength was evaluated as the peak load prior to failure. Dermabond influence was tested using a one tail t-test to obtain p-values to determine statistical significance. **Results:** *insert figure: emailed to mtucci@umc.edu *

Figure 1. Peak load [N] required to break the suture. The findings are averaged over a trial size of n=8, and the experimental group data is taken from the results of testing on day 0 following application of Dermabond.

Conclusion: Dermabond did not have equal effects on each type of suture. Specifically, Dermabond augmented the tensile strength of all the sutures tested ($p<0.05$) except for Silk ($p=0.052$). The Silk control peak tension before failure was 31.60 N±0.67 compared to 32.52N±1.33 with Dermabond. Vicryl showed the greatest augmentation with a 44.4% increase from 43.70N±4.49 to 63.10N±2.99 with Dermabond (p value=$3.17x10^{-8}$). Our findings suggest that Dermabond, when applied directly to knots of suture, increases their tensile strength in comparison to the same knots alone for 4 out of 5 of the suture types tested. Knowledge of this adaptive increase in strength may improve wound closure integrity in areas subject to higher tension.

185 - UNVEILING NEW AGENTS FOR MUTANT HER2T798I BREAST CANCER*: in silico* STUDY

Wafa Masoud[1], Radwan Alnajjar[2], Hamed I. Ali Ali[3]

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Cancer is a disease in which some of the body's cells grow uncontrollably and spread to other body parts. Among others, breast cancer (BC) presents 43% of the women's cancer cases in Libya during the 2020-2021 period. HER-2 (+) BC is the most common breast cancer with Lapatinib as frontline chemotherapy; however, due to widespread resistance to Lapatinib, Trastuzumab is being used nowadays, which is an antibody agent. Due to the high cost of Trastuzumab, a chemotherapy that has a similar mechanism of action to lapatinib is required. Herein, we attempt to find a new agent for mutated HER2 using a database of 1,474,068 compounds obtained from ChemDiv, prepared, and high-throughput virtual screened against HERT798I. The best 1000 compounds were subject to standard precision docking, followed by extra precision (XP) for the best 200 among them. The frontrunner compounds were subject to molecular dynamics simulation, and their drug-likeness properties were evaluated.

Notably, compound **856174** demonstrated a high docking score (-9.92 $kcal.mol^{-1}$), favorable interactions, including hydrogen bonds with THR 862 and methionine 801 (98%), water bridges with leucine 753 and serine 783 (50%), and hydrophobic bonds with Leu 726, Ala 751, and Leu 785. Compound 856174 also exhibited desirable physicochemical properties, such as moderate solubility, a molecular weight less than 500 Da, and a TPSA of 99.37, along with low hepatotoxicity, high GI absorption, and stability. Further, *In vitro* investigations are needed to determine the effectiveness of compound 856174 in breast cancer treatment.

186 - BIOLOGICAL AND ENVIRONMENTAL IMPLICATIONS OF USING WASTE GLASS POWDER AS CEMENT AND SAND REPLACEMENT IN CONCRETE

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The disposal of non-biodegradable waste materials such as glass poses a significant threat to environmental and human health. This study explores the sustainable reuse of waste glass powder (WGP) as a partial replacement for cement and natural sand in concrete, focusing not only on mechanical performance but also on the broader environmental and biological benefits.

Concrete mixtures were formulated using three water/cement (w/c) ratios (0.45, 0.55, 0.65) with WGP replacing cement at 0%, 10%, and 15%, and sand at 0%, 25%, 50%, and 75%. Compressive strength tests conducted at 28 days revealed that while cement replacement with WGP reduced strength, sand replacement improved performance, especially at higher substitution ratios. Optimal results were observed at a 0.45 w/c ratio with 75% sand replacement, effectively compensating for strength loss due to lower cement content.

Beyond mechanical outcomes, this substitution strategy offers critical environmental and public health advantages. Cement production is a major contributor to CO_2 emissions and particulate air pollution, both of which have established links to respiratory and cardiovascular diseases. Replacing a portion of cement with WGP reduces these emissions and limits occupational exposure to cement dust. Additionally, the reuse of glass waste minimizes landfill usage and associated soil and groundwater contamination risks, thereby mitigating long-term ecological and biological hazards.

This study highlights a promising pathway for integrating industrial waste into construction materials in a manner that aligns with both structural requirements and human health goals. The findings support broader adoption of waste-derived materials as an integral part of green building initiatives aimed at fostering a healthier built environment.

187 - EXPLORING BURNOUT AND TURNOVER INTENTIONS AMONG NURSING FACULTY IN MISSISSIPPI

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Background: The Health Resources and Services Administration (HRSA)(2022) projected a shortage of 78,610 registered nurses in 2025 and 63,720 in 2030. A key factor contributing to the shortages is the lack of nursing faculty. In Mississippi, the 2022 data indicated that nursing schools around the state turned away 2,400 qualified applicants, in part due to a nursing faculty shortage (Taft, 2022). To address the urgent shortage issue, it is essential to understand the contributing factors. **Objective:** This study aimed to employ a mixed-methods study design to evaluate Mississippi nursing faculty's compassion satisfaction (CS), burnout (BO) and secondary traumatic stress (STS), as well as factors that influence their intent to stay or leave the profession. **Methods:** Two conceptual theories were followed to guide this study - the ProQOL theory proposed by Stamm (Stamm, 2010) and the four-dimension measure of occupational commitment theory by Blau (Blau, 2003). A sequential explanatory mix-methods study design was employed (Creswell & Clark, 2017). The target population for this study was nursing faculty in academic nursing programs in Mississippi. The data were collected in two consecutive phases, first quantitative and then qualitative. The quantitative phase involved an anonymous cross-sectional survey to all nursing faculty in Mississippi. The qualitative phase entailed semi-structured individual interviews with survey respondents who indicated their interest in participating in an interview. The quantitative data were analyzed with Stata 18. The qualitative data were analyzed with the Constant Comparative Method (CCM). **Results:** From the quantitative data, 80.2% of nursing faculty reported low compassion satisfaction (CS) scores (<23; M = 14.7, SD = 9.3). Additionally, 78.4% reported medium or high levels of burnout (BO; >23; M = 30.0, SD = 16.6), and 76.5% reported medium or high levels of secondary traumatic stress (STS; M = 31.0, SD = 17.3). Several demographic characteristics—including race, age, years at the current institution, weekly work hours, and salary—were significantly associated with one or more of the three outcomes (CS, BO, or STS). Notably, faculty who indicated an intention to leave their position reported significantly higher levels of BO and STS. From the qualitative data, faculty reported that their job satisfaction primarily stemmed from a passion for teaching and positive interactions with students. In contrast, those experiencing burnout attributed it to poor work-life boundaries, excessive workload, and a lack of a cohesive work environment. Despite the widespread experience of burnout, most faculty expressed an intention to remain in academia, citing the clinical environment as a more demanding alternative. **Conclusion:** Nursing faculty reported significantly lower levels of CS compared to other healthcare professionals in similar studies conducted by the authors. The insights gained from this research have direct implications for the field of nursing as they will contribute to the development of targeted nursing faculty retention strategies, policies, and interventions, which will, in turn, help address the current nursing shortage in Mississippi.

188 - ESTROGEN-COATED VAGINAL EXPANSION SLEEVES LENGTHEN THE RAT VAGINAL CANAL

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BACKGROUND: Vaginal atresia is characterized by an underdeveloped or absent vaginal canal from genetic disorders such as Mayer-Rokitansky-Kuster-Hauser. Current treatment methods utilize invasive mechanical dilation and reconstructive surgery associated with high complication rates. Previous studies in our lab suggest the use of a novel minimally-invasive vaginal expansion sleeve (VES) to successfully lengthen the vaginal canal in Sprague Dawley rats. However, histological analysis demonstrates the thinning of the vaginal wall characterized by compression of the soft tissue and stretching of muscle fibers. Treatment with adjunct GLP-2 shows successful lengthening with mild to moderate inflammation. Estrogen is associated with antiinflammation through several pathways, including generation of nitric oxide and inhibition of tumor necrosis factor-α. In this project, we aim to investigate the effects of estrogen coating on the VES sleeve functionality. We hypothesize that estrogen contributes to expansion and thickening of the vaginal wall. **METHODS**: The VES sleeve is a polyethylene terephthalate cylindrical tube with a biocompatible resin cap. Topical estrogen was coated onto the VES before implantation into the vaginal canals of six Sprague Dawley rats and secured in place with non-absorbable sutures. Sleeves were replaced weekly and progressively increased to facilitate tissue expansion. Following three consecutive sleeve replacements, the VES was removed for two weeks. Vaginal lengths were longitudinally measured through the five-week trial. **RESULTS:** Estrogen-coated VES yielded an overall retained rat vaginal wall length of 34.8mm compared to an average control vaginal wall length of 29.3mm, yielding an increase of 19.0% compared to controls ($p < 0.001$). **CONCLUSION:** VES expansion with adjunct estrogen successfully lengthens vaginal canals, confirming that the estrogen coating did not affect the functionality of the device. Histological analysis of the acquired post-mortem specimens of the vaginal canals will focus on the inflammatory response.

189 - BUILDING BRAINS, NOT JUST BODIES: THE IMPACT OF APPLYING CONSTRUCTIVIST APPROACHES IN GROSS ANATOMY

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Introduction: The complexity of today`s educational system, especially medical education, has put many challenges and demands on educators and learners. Educational psychologists have provided us with various educational theories, however, there is no single universal approach. One educational theory, constructivism, suggests that learners build knowledge based on previous experiences. Some teaching techniques that use constructivism as a framework in inquiry-based learning, team-based learning, and problem-based learning. The purpose of this session is to highlight the use of constructivism in medical education and to demonstrate a unique example of integrating this theory in gross anatomy. **Materials and Methods:** This educational activity was conducted in the Spring semester of 2025 for first-year dental students at the University of Mississippi Medical Center (UMMC). It involved pre- and post- gross anatomy laboratory activities and survey feedback. The pre-lab atlas-based activity was completed prior to dissection, whereas the post-lab cadaveric-based activity was completed after. Survey feedback of five Likert scale questions and two open-ended questions was distributed twice after block 1 and block 3 exams. Quantitative data was analyzed using a paired t-test to compare group averages, and qualitative data was analyzed using thematic analysis. **Results:** First-year dental students showed improved performance comparing block 1 and block 3 pre- and post-lab activity averages (block 1 pre-avg: 0.82 vs. block 3 pre-avg: 0.92) with a (p-value <0.009); (block 1 post-avg: 0.74 vs. block 3 post-avg: 0.91) with a (p-value <0.002). Among the themes, students described the pre-lab activity as a foundational step before the start of the dissection. For example, one student said: "*Cadaveric images give me more confidence in the lab identifying structures in the future, but atlas images are a good foundation before dissection as they make it easier to dissect between the structures. Overall, both are helpful."* The post-lab activity, on the other hand, made them more confident in identifying structures and using anatomical terminology. For example, one student said: "*I think these were incredibly helpful. Cadaveric images are much more helpful than the textbook in identification practice. The pre-lab also helped with using the correct terminology."* **Discussion:** Consistent with previous literature, our findings showed that the use of constructivist approaches in medical education has a significant impact on student performance and confidence. The pre-lab average for block 1 measured (0.82) while pre-lab average for block 3 measured (0.92) with a (p-value <0.009). The post-lab average for block 1 measured (0.74) while post-lab average for block 3 measured (0.91) with a (p-value <0.002). **Significance and Implications:** This educational activity highlights the significant impact of constructivist approaches when applied in the gross anatomy laboratory.

As for the learners, they participate actively, think critically, construct their own knowledge, and collaborate with others. Whereas for the educators, they facilitate the learning session, enhance performance and confidence, and ensure a richer and more successful learning environment.

190 - NAVIGATING ETHICAL CHALLENGES IN BIOENGINEERING RESEARCH

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The rapid advancement of biomaterials in bioengineering presents a complex landscape of ethical challenges. As these technologies transition from preclinical research to clinical implementation, several key ethical considerations emerge including concerns related to; biocompatibility, informed consent and autonomy, ownership and property rights, privacy and confidentiality, cultural and religious sensitivities, translational delivery and accessibility, chimeric and organoid research and research oversight of both animal and human subjects. Bioengineers must navigate these challenges while balancing benefits vs. risks, anticipating unforeseen consequences, and managing competing ethical priorities. Resource limitations and rapidly evolving technologies further complicate ethical adherence. Researchers and biomedical engineers must prioritize responsible research practices, such as research ethics training, institutional ethics committees, and adherence to codes of ethics. To address these issues, bioengineers are guided by established codes of ethics, such as those from the Biomedical Engineering Society (BMES) and the National Society of Professional Engineers (NSPE). These codes emphasize principles like harm avoidance, professional responsibility, informed consent, risk assessment, and environmental impact. Key issues include ensuring patient safety, minimizing harm, and promoting transparency and accountability in biomaterials research and development. By proactively addressing these ethical dilemmas, the biomaterials community can ensure the responsible translation of biomaterials research and its benefits to human health. In conclusion, the ethical landscape of bioengineering is intricate and evolving. Continuous ethical reflection and striving to adhere to established ethical frameworks are essential to ensure responsible biomedical innovation in the advancement of public health.

191 - LEAD-FREE Ca3BiX3 (X = F, Cl, Br, and I) HALIDE PEROVSKITES FOR PHOTOVOLTAIC AND ENERGY HARVESTING APPLICATIONS: A FIRST-PRINCIPLES STUDY

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In the modern world, when industry and population are growing at a rapid pace, energy demand is a significant global concern [1]. To meet this energy demand, lead-free halide perovskites have emerged as excellent candidates for next-generation energy harvesting devices owing to their environmentally friendly composition and exceptional ability to utilize sustainable resources. Moreover, perovskites demonstrate adjustable optical and electrical properties, making them appealing for various microelectronics and energy-related applications [2]. This study examines the viability of expanding the application of lead-free Ca3BiX3 (X = F, Cl, Br, I) as potential materials in energy conversion and harvesting due to their superior electronic, mechanical, optical, thermodynamic, piezoelectric, and thermoelectric properties, utilising first-principles calculations based on Density Functional Theory (DFT). The examined compounds possess cubic crystal structures, and their phonon dispersion spectra are used to determine their dynamic stability. The lattice parameters of the compounds demonstrate a linear increase from 5.72 to 6.42 Å as the halide is substituted from F to I, due to a bond length decrease, which modifies their physical properties. The bandstructure profile showed the direct band gap (Γ-Γ) nature of Ca3BiX3 (X = F, Cl, Br, I) compounds. The band gap values are 1.96, 1.79, 1.60, and 1.29 eV for Ca3BiF3, Ca3BiCl3, Ca3BiBr3, and Ca3BiI3, respectively. This study demonstrates the superior optical characteristics of the examined perovskite materials, featuring an expanded spectrum response, heightened sensitivity, and an enriched dielectric constant. Their brittle and anisotropic nature, along with other improved mechanical features, is revealed by determining their elastic constants, which also confirms their mechanical stability through Born stability criteria. The thermodynamic features demonstrate their capacity to endure and function well at elevated temperatures. The thermoelectric properties of Ca3BiX3 (X = F, Cl, Br, I) were evaluated by measuring electrical and thermal conductivity, Seebeck coefficient, power factor (PF), and figure of merit (ZT) as a function of temperature. All compounds demonstrate elevated PF and nearly unity ZT. Lastly, their piezoelectric characteristics will reveal their ability to convert the abundant mechanical energy of the environment to usable electrical energy. Because of their remarkable characteristics, these materials have the makings of excellent optoelectronic and energy-harvesting devices.

192 - AI IN YOUR POCKET: A SMARTPHONE PLATFORM FOR BUILDING MEDICAL CHATBOTS

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Background: Recent advancements in artificial intelligence (AI) have transformed healthcare, enabling innovative applications such as deep learning for medical image analysis and large language models (LLMs) for clinical decision support. However, many medical professionals face challenges in developing AI-powered applications due to constraints in time, resources, and software development expertise. This study presents an open-source, smartphone-based platform designed to simplify the creation of AI-driven medical applications with minimal coding effort. **Results:** The platform leverages Flyer Chat, an open-source chat application, to implement an AI- powered medical chatbot that integrates the ChatGPT API for diagnosis. It provides function templates where developers can drop in code segments in response to user actions, such as pressing the send button. A sample chat application for diagnosing respiratory infections is included. Additionally, the platform supports classification of smartphone camera images by incorporating TensorFlow Lite Model Maker, allowing users to train and deploy machine learning models for medical image analysis. A sample application for classifying skin disease images is included. **Conclusion:** By providing an accessible framework with pre-built templates and AI integration, this platform empowers healthcare professionals to develop and deploy AI-driven smartphone solutions without requiring extensive programming expertise. This approach facilitates the adoption of AI in medical applications, expanding access to intelligent healthcare tools for improved patient outcomes.

193 - SHORT BOWEL SYNDROME: PURSUING A 'LONGER' INTESTINAL SEGMENT VIA DISTRACTION ENTEROGENESIS

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Short bowel syndrome (SBS) affects approximately 30,000 individuals annually in the U.S., resulting from significant intestinal tissue loss due to conditions such as volvulus, necrotizing enterocolitis, Crohn's disease, trauma, or unknown causes. The small intestine, responsible for nutrient absorption, adapts by dilating rather than lengthening, often leading to long-term dependence on total parenteral nutrition (TPN). Many SBS patients never fully wean off TPN, which carries risks like central line infections, liver disease, and organ failure. The annual Medicare cost for TPN ranges from $64,000 to $128,000 per patient, contributing to a total societal cost of $1.9 billion, excluding hospitalizations and other healthcare services. SBS also affects patients' ability to work and lead independent lives. The keynote will explore the historical approaches to treating short bowel syndrome and introduce the emerging paradigm of distraction enterogenesis. It will delve into the technical challenges associated with this innovative method and examine how these obstacles have shaped device requirements—highlighting recent advancements that are pushing the boundaries of what's possible in intestinal regeneration.

194 - ORGANIC-INORGANIC HALIDE PEROVSKITE AND BIO-BASED ENERGY HARVESTER FOR SUSTAINABLE SELF-POWERED WIRELESS SENSING

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As the world advances toward smart, interconnected systems and ubiquitous sensing, the need for sustainable, self-powered technologies has become essential. This talk highlights recent advancements in the development of high-performance, flexible nanogenerators (NGs)—both piezoelectric (PENGs) and triboelectric (TENGs)—designed for next-generation wireless electronics and environmental sensing applications. A significant focus has been placed on replacing toxic lead-based materials with eco-friendly alternatives. We demonstrate a novel class of lead-free nanogenerators using formamidinium tin halide ($FASnBr_3$) perovskites stabilized by SnF_2 and embedded in soft polymer matrices such as PVDF and PDMS. These flexible PENGs exhibited enhanced air stability, high piezoelectric charge constants (d_{33} ~50 pm/V), and exceptional energy output—up to 94.5 V and 19.1 µA under low mechanical stimuli—sufficient to power RF wireless communication between electronics nodes.

Complementing this, we explored the intrinsic piezoelectric properties of single microcrystals of cesium lead chloride ($CsPbCl_3$), achieving g_{33} values surpassing traditional ceramics. These were further integrated into composite NGs capable of generating ~40 V and 111 µW output under ambient force, showcasing their practical viability. On the triboelectric front, we introduced wood-derived lignocellulosic nanofibrils (LCNF) as a high-performing, biodegradable alternative to fluorinated polymers. LCNF-based TENGs significantly outperformed conventional PTFE devices, enabling continuous wireless data transmission in self-powered systems.

Collectively, this body of work emphasizes the design, chemical engineering, and integration of high-output, flexible, and environmentally friendly nanogenerators for powering sensors and IoT nodes. It paves the way for

greener electronics, structural health monitoring, and sustainable energy harvesting platforms that align with global environmental stewardship goals.

195 - PREDICTING ALZHEIMER'S DISEASE USING DATA FROM BRAIN IMAGING ALTERNATIVES

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Alzheimer's Disease (AD) has remained one of the top ten causes of death globally for the past several years. Due to increased life expectancy and an aging population worldwide, a steady rise in the population affected by AD and other forms of dementia is forecasted by 2050. With the baby boomer generation soon reaching the high-risk ages, accurate prediction of early-onset AD is an urgency, especially in the United States. In recent years, triangulation of multiple sources of reports such as patient cognitive tests, biomarkers, and advanced brain imaging, claims to have enabled improved diagnoses and prediction. This study attempts to identify the most weighted determinants of AD and to test whether cost-effective data sources such as medical history, biomarkers, socioeconomic status, and general health are effective in predicting Alzheimer's without expensive brain imaging reports. For this study, data from Alzheimer's Disease Neuroimaging Initiative (ADNI) was used for preliminary analysis. ADNI is an ongoing longitudinal study of participants aged 55 to 90 years beginning in 2004. The aim of ADNI is to investigate the progression of Alzheimer' disease over time. For this study, the baseline subjects (N=1,798) over the four phases (ADNI 1, ADNI GO, ADNI 2 and ADNI 3) were observed. The main objective of the study was to assess the predictability of imaging versus non-imaging data for Alzheimer's disease. The unit of analysis was the patient. Variables pertaining to socioeconomic indicators, genetic and blood biomarkers, cognitive test scores and medical history (non-imaging) were modelled to predict Alzheimer's, controlling for MRI biomarkers (imaging). Missing values were imputed by average values, upon observing the distribution. Using Singular Value Decomposition (SVD), significant components were identified separately for Medical History, Cognitive Tests and MRI markers. The SVD components, gender, education years, genetic marker and other variables, were all added to the model. The MRI markers were found to explain only 25 per cent of the variance of AD (adjusted R^2=0.25). However, it was found that non-imaging data such as genetic and blood biomarkers and general medical history could explain 61.1 per cent of the variance (adjusted R^2=0.611), whereas combined imaging and non-imaging data improved the explainability by only 0.2 per cent (adjusted R^2=0.613). The preliminary findings suggest that statistically, expensive MRI imaging may not be necessary to predict Alzheimer's disease. Cognitive tests and blood biomarkers alone may be sufficient to diagnose Alzheimer's. This may have cost implications for remote rural or financially disadvantaged elderly population. As evidenced from this large dataset, the study also indicates the insufficiency of the MRI markers, typically used for AD.

196 - MODELING SURFACE TEMPERATURE AND INFLUENZA-LIKE ILLNESSES USING SATELLITE DATA

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Introduction: Influenza-like illness (ILI) has always posed a significant burden on public health systems worldwide, often resulting in seasonal outbreaks that strain healthcare resources. While these outbreaks show strong seasonal patterns, the environmental factors influencing their seasonality remain complex and not fully understood. Among these environmental factors, surface temperature has been frequently cited as a potential driver, with proof suggesting that significant temperature changes precede trends in ILI cases. Our study aims to model the temporal offset between changes in surface temperature and subsequent ILI incidents. A key gap in previous works is the lack of focus on the conditions that trigger the onset of a surge in ILI cases. Our contribution addresses this by introducing a model capable of identifying these early indicators that signal the beginning of an ILI surge. By leveraging the models, SARIMAX and Multivariate LSTM models, and integrating NASA satellite data with Google Earth Engine (GEE) for surface temperature remote sensing alongside ILI records, we are offering a proactive approach to epidemic surveillance.**Methods:** Our study hypothesizes that decreases in surface temperature precede an increase in ILI cases by a measurable response window and incorporating surface temperature as a lagged exogenous variable can improve the forecast accuracy of ILI cases. We sourced ILI weekly percentage data from 2015 to 2024, from Chicago, Illinois health surveillance records, an interesting dataset; 5 years pre-COVID-19 and nearly 5 years post-COVID-19. We processed weekly surface temperature data from NASA's MODIS Land Surface Temperature and Emissivity daily data using GEE, aggregated to match the ILI weekly records. The models were trained and tested on appropriate subdivisions of the dataset, respectively. **Results:** Our study has uncovered patterns where a drop in surface temperature precedes a rise in ILI cases. The preceding interval analysis aims to

quantify the temperature change and how many weeks in advance it can signal the beginning of a surge in ILI cases. We identified an optimal lag interval of 1 to 3 weeks that initiates the start of a small surge, and a prerequisite for larger surges. The temperature changes that influence a surge were found to vary at different times, especially post-COVID-19. With a combination of weather forecast tools, these results will contribute to understanding the time-sensitive influence of environmental variables on ILI forecasting. **Conclusion:** Our study provides insight into the lagged relationship between surface temperature and ILI in Chicago, Illinois, from 2015 to 2024. Although the ILI trends have significantly changed post-COVID-19, by integrating surface temperature data as an exogenous variable into the time series forecasting model, our study provides actionable patterns for the timely prediction of ILI surges, which is essential for effective public health surveillance and epidemic control strategies. Ultimately, this approach emphasizes the value of environmental-health modelling as a tool for data-driven decision-making in health policy and outbreak mitigation. The integration of Earth observation and forecasting data with epidemiological trends holds significant promise for anticipating outbreaks, mitigating risks, and saving lives.

197 - SPINAL SEGMENTATION WITH A HYBRID VISION TRANSFORMER FOR THE SPIDER CHALLENGE

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Lower back pain (LBP) ranks among the primary causes of disability globally, frequently linked to structural alterations in the lumbar spine. Precise segmentation of spinal components from MRI images is essential for accurate diagnosis and treatment strategies. This research introduces a Vision Transformer (ViT)-based method for the automatic segmentation of vertebrae, intervertebral discs (IVDs), and the spinal canal in sagittal T2-weighted MRI scans, developed as part of the SPIDER Challenge on the Grand Challenge platform. Although convolutional neural networks (CNNs) such as nnU-Net have shown significant efficacy in these tasks, we propose that transformer-based models may provide enhanced generalization through their global attention mechanisms. Our proposed approach utilizes a hybrid architecture influenced by TransUNet, which combines a ViT encoder with a streamlined convolutional decoder. Initially, the input MRI volumes underwent preprocessing that included resampling and intensity normalization. To address the varying spatial resolutions and field-of-view present in the dataset, adaptive cropping and resizing techniques were employed to maintain anatomical consistency. We extracted 2D sagittal slices from the 3D volumes for the training phase and implemented various data augmentations, such as affine transformations, elastic deformations, and contrast modifications. The ViT encoder was pre-trained on ImageNet and subsequently fine-tuned with the SPIDER training dataset. The decoder features multi-scale feature maps along with skip connections from earlier transformer layers, enhancing spatial refinement. Our loss function integrated Dice loss with cross-entropy to address class imbalance, particularly concerning the spinal canal, which constitutes a smaller portion of the image space. Evaluation was conducted on the SPIDER validation set and hidden test set, utilizing the Dice Similarity Coefficient (DSC) as the primary evaluation metric. The model attained mean DSC scores of 0.917 for vertebrae, 0.882 for intervertebral discs, and 0.903 for the spinal canal, culminating in an overall mean DSC of 0.900. These outcomes are competitive with the CNN-based baseline (nnU-Net), demonstrating enhanced segmentation consistency in scans characterized by significant disc degeneration or low contrast. Qualitative analysis validated the capability of the ViT-based model to preserve structural continuity and identify fine boundaries, particularly in complex scenarios. The attention maps indicated a strong global awareness of the spinal context, facilitating robust performance among patients with diverse spinal curvatures and pathologies. This work illustrates the practicality and efficacy of ViT-based architectures for lumbar spine MRI segmentation. Although more computationally demanding than conventional CNNs, the transformer methodology holds potential for clinical applications where generalization across different institutions and scanner types is essential. Future research will aim to expand the model to 3D volumetric transformers and integrate clinical metadata to support multi-modal diagnosis.

198 - PREDICTING SLEEP SCORES - MODELING INSIGHTS

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The quality of sleep in humans is essential for the sustenance of general health and well-being. In contemporary society, the ubiquitous use of wearable technology in the form of wearables like Fitbit has enabled individuals to track their sleeping patterns and get measurable sleeping scores. Such scores, generally on a 0 to 100 scale, indicate the restorative nature of sleep by quantifying a number of physiological and behavioral parameters like heart rate, levels of restlessness, and sleeping duration. The primary aim of this research is to establish the best predictive model in sleep score

evaluation, and most important factors that have a significant impact on sleep quality. Despite the advances in consumer health technology, there exist significant research gaps. Most ongoing studies are based on data collected using clinical-grade devices like polysomnography, which are limited to laboratory settings and do not have ecological validity. Furthermore, existing prediction models fail to address the key elements of interpretability and personalization, offering little insight into providing inferences that are tailored to individual users. Additionally, there is a shortage of optimized machine learning pipelines specific to analyzing real sleep data acquired from wearable devices, consequently hindering model real-world applicability and generalizability. To overcome such limitations, we utilized two datasets—one of full overnight sleep data (7 features) and one of the respective sleep scores (7 types of scores) —and a supervised machine learning pipeline. With an 80-20 split, we tested multiple models for sleep score prediction with particular emphasis on Random Forest, Light Gradient Boosting Machine (LightGBM), and TabNet. Random Forest was the baseline, based on prior work on this dataset. Among the models tested, Random Forest showed promising baseline performance with MAE of 1.92, MSE of 6.09, R^2 of 0.80, and accuracy of 97.61%. LightGBM, which was also optimized with Bayesian Optimization for hyper-parameters, showed better performance than all models with MAE of 1.24, MSE of 2.69, R^2 of 0.91, and prediction accuracy of 98.46%. In contrast, TabNet, a known high-performing deep learning-based model for tabular data, showed poorer performance compared to the tree-based and boosted models, with an MAE of 3.07, MSE of 13.17, R^2 of 0.57, and an accuracy rate of 96.20%. We also tried variations of basic Multi-Layer Perceptron deep learning models, but results were poorer. These results show that while deep learning has intrinsic potential, boosted machine learning models currently demonstrate higher accuracy and generalizability in this specific domain. Feature importance from the LightGBM model revealed that total sleep minutes, deep sleep, number of awakenings, and resting heart rate were the strongest predictors of sleep score. These results not only confirm the model's ability to predict sleep score accurately but also have real-world applications for individuals who desire to improve sleep quality through lifestyle or behavioral modifications.

199 - MedQ: AN AI-DRIVEN QUEUING SYSTEM FOR OPTIMIZED PATIENT FLOW

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Inadequate patient flow remains a significant problem in healthcare centers, mainly because of the prevalence of legacy, manual queuing systems. Long waiting times, slow service, and administrative delays often translate into patient dissatisfaction and employee burnout. Traditional token-based systems tend to be inflexible and opaque, non-adaptive, and non-real-time responsive—ultimately leading to ineffective utilization of resources and workflow inefficiencies. There is a vital missing link in the queuing systems implemented: the absence of an intelligent, automated system aligned with the dynamic and multivariate characteristics of contemporary healthcare settings.

To overcome these drawbacks, we propose MedQ, an AI Driven, intelligent, web-based queuing system to organize patient flow and service delivery in hospital departments. MedQ allows patients to create tokens either via an online portal or on-premise kiosks with the option of pre-selecting departments or services. The system intelligently handles and monitors queues by regulating token issuance according to real-time departmental load and patient flow status. The system features Role-Based Access Control (RBAC) for hierarchical, secure user access, database triggers and stored procedures for token processing streamlining and critical workflow automation, and a comprehensive administrative dashboard with real-time queue status, departmental workload, and performance metrics to give administrators actionable intelligence. Patients also receive insight into their place in the queue, thus eliminating uncertainty and promoting transparency. MedQ's major functional elements have been built with flexibility and performance optimization considerations. Its load-balancing algorithm reroutes or reorders tokens dynamically, dependent on real-time departmental workload and estimated wait time, in order to achieve patient traffic equilibrium. Real-time queue adjustment logic enables the system to automatically renegotiate token priority when unexpected delays occur—such as the short-term unavailability of medical staff—thus providing continuity of service without the need for human intervention. In addition, the system uses highly optimized stored procedures that minimize the execution time of queries by considering the current queue state, improving database performance and application responsiveness.

MedQ showed considerable enhancement in reducing wait times, transparency of services, and operational effectiveness in simulated hospital settings. In addition, the system's modular design and reporting capabilities provided centralized performance monitoring and reduced manual intervention and errors. The importance of this study is in the potential of MedQ as a reproducible model for healthcare institutions aiming to update patient queuing and

flow management. In closing the gap between static token systems and intelligent service orchestration, MedQ provides a scalable, adaptive solution aligned with institution performance goals and patient-centered care. Future system upgrades involve the incorporation of AI-driven wait-time prediction, token generation and exchange assisted by chatbots, and multilingual support to cater to heterogeneous patient populations. These upgrades will further augment MedQ's scope and usefulness in practical healthcare environments.

200 - PANCREATIC CANCER DETECTION USING DIELECTROPHORESIS-BASED RECOVERY OF CIRCULATING CANCER-DERIVED NANOPARTICLES

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Diagnosing pancreatic cancer through blood-based biomarkers remains a complex and challenging process, primarily due to significant variability in biomarker expression levels across different patients. To address this heterogeneity, the use of diagnostic panels composed of orthogonal biomarkers whose expression levels are based on different cancer related mechanisms can account for a greater amount of this heterogeneity compared to a single biomarker type. One promising source of such orthogonal biomarkers are tumor-derived nanoparticles, which can be actively or passively released into the bloodstream. These include extracellular vesicles (EVs), which are actively secreted by tumor cells, and cell-free DNA (cf-DNA)-containing nanoparticles, which are typically released through the passive breakdown of necrotic tumor tissue. A major challenge to using these diverse nanoparticle types for diagnostic purposes is the fact that each type of nanoparticle typically requires a different method of recovery from plasma. These methods can be labor-intensive, time-consuming, and require large volumes of plasma, making them poorly suited for clinical translation and widespread diagnostic use. To address this challenge, we have developed a dielectrophoresis (DEP)-based nanoparticle collection technology that enables the simultaneous isolation of multiple nanoparticle types from small volumes of undiluted plasma, simplifying and streamlining the diagnostic workflow. Using microfluidic chips equipped with microelectrode arrays, we applied alternating electric fields to the plasma samples. The DEP forces generated by the electrode array can simultaneously attract the EV and (cf)-DNA nanoparticles to the electrode edges where the field strength is the highest. This collection step takes 10 min followed by a 10 min washing step that removes the bulk plasma. Subsequent biomarker quantification was performed using immunostaining for Glypican-1, a pancreatic cancer-related protein biomarker, and SYBR Green stain, which is a DNA-intercalating dye, to quantify the cf-DNA nanoparticles. Optical imaging was then used to quantify biomarker levels directly on the chip which avoided fluid transfers thereby preventing potential loss of biomarker and maximizing overall signal. We utilized support vector machine (SVM) machine learning algorithms to differentiate the cancer patients from those with benign pancreatic diseases including benign cysts, inflammatory pancreatitis, and notably, precancerous lesions using a blinded cohort. The biomarker panel achieved a sensitivity of 0.92, a specificity of 0.83, and an area under the curve (AUC) of 0.93. Importantly, the diagnostic performance improved further in patients over the age of 50, reaching an AUC of 0.97. These results show that nanoparticle-based diagnostics can perform better than the current standard invasive and costly diagnostic tissue biopsy procedure (AUC of 0.79) which uses endoscopic ultrasound-guided fine-needle aspiration (EUS/FNA). Our findings highlight the significant clinical potential of DEP-based technology as a minimally invasive, efficient, and scalable method for recovering and analyzing multiple classes of tumor-derived nanoparticles. This method demonstrates the potential of multi-biomarker diagnostic DEP platforms that are based on cancer-derived nanoparticles for future clinical translation.

201 - OPTIMIZING IODINE-124 PET IMAGING PROTOCOL FOR THYROID CANCER ABLATION USING PHARMACOKINETIC MODELING

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Purpose: Although not routinely performed in clinical practice, serial Iodine-124 PET/CT imaging has been utilized in research settings to estimate lesion-specific radiation dose in patients with differentiated thyroid cancer (DTC) following thyroidectomy and prior to Iodine-131 ablation. Current approaches often rely on simplified methods, such as trapezoidal integration, which may inadequately capture the underlying iodine kinetics. This study proposes a two-compartment pharmacokinetic model to improve dose estimation accuracy and explores protocol optimization by reducing the number of imaging time points while preserving clinically acceptable dosimetric precision. **Methods:** Iodine kinetics were modeled using a two-compartment framework consisting of an extracellular and a thyroidal compartment. The system was described by a bi-exponential function of the form , with λ_1 and λ_2 representing absorption and clearance rates, respectively. As part of an IRB-approved prospective clinical trial, six

patients with DTC underwent serial I-124 PET/CT imaging following oral administration of the radiotracer. A total of 13 thyroid remnants were identified. Each patient received five PET/CT scans at approximately 2, 24, 48, 72, and 96-hours post-ingestion. Bi-exponential fitting was performed with six time-points per lesion (including t=0) using two constrained regression approaches to minimize residual error and ensure physiological plausibility. Using the full six-time-point dataset as the reference standard, we evaluated simplified imaging protocols with four, three, two, and a single time-point. For each reduced schedule, cumulative activity estimates were compared against the reference to quantify the trade-off between fewer imaging sessions and loss in dosimetric accuracy. **Results:** The bi-exponential model effectively captured intra-thyroid iodine kinetics, separating absorption and elimination phases. Among 13 thyroid remnants among the 6 patients, the average rate constants were $\lambda_1 = 0.0141$ hr^{-1} and $\lambda_2 = 0.0953$ hr^{-1}. The activity scaling factor (A) exhibited substantial inter-lesion variability, influenced by remnant volume, uptake, and patient-specific physiology. Using the full six-time-point dataset as reference, reduced imaging protocols were evaluated. Three-time-point protocols (e.g., 2, 24, 48 hr) yielded moderate deviations (mean: -6.82%; SD: 29.48%), while single-time-point protocols (e.g., 24 or 48 hr) showed larger variability and reduced accuracy. Protocols including both early and mid-phase time-points (e.g., 2, 24, 48, 72 hr) provided the best trade-off between acquisition burden and dosimetric precision (mean: 0.38%; SD: 12.19%). **Conclusion:** Incorporating a pharmacokinetic modeling approach improves the accuracy of dose estimation for thyroid remnants and enables optimization of imaging protocols. Our results highlight the importance of iodine kinetic parameters and demonstrate that reduced-time-point protocols—particularly three-point combinations—can maintain clinically acceptable accuracy. This strategy enhances patient convenience, lowers healthcare burden, and supports the broader implementation of precision dosimetry in DTC management.

202 - LEARNERS AS TEACHERS: STRATEGIES FOR PEER TEACHING FROM A CONSTRUCTIVIST PERSPECTIVE

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Despite mounting evidence that active learning may improve student performance and perceptions in STEM education, faculty teaching loads, research and service commitments often restrict the ability to devise and implement alternative, student centered teaching activities. Peer teaching approaches offer a potential solution to this problem. Dosoftei et al. 2024 demonstrated increased self-confidence, academic performance, teamwork and knowledge consolidation among undergraduate engineering students who participated in peer teaching. The peer teaching approach, which is grounded in the constructivism theory of learning, has also been linked to student improvements in traditional classroom settings and lab sessions in other fields, such as in medical education. This presentation has three aims: 1) to identify foundational learning theories that underpin peer teaching in STEM education, 2) to describe strategies for integrating peer teaching into classroom and laboratory-based STEM education and 3) to describe the dual benefits of peer teaching to both the student learner and the peer teacher. This will be accomplished by first, examining foundational learning theories such as Vygotsky's Social Constructivism and Collins' Cognitive Apprenticeship in the context of STEM education. Second, specific use cases of peer teaching such as Think-Pair-Share, Jigsaw, Near-Peer Tutoring and other methods will be described. Finally, research describing the benefits to the student learner and to the peer teacher will be examined. STEM education continues to evolve as programs strive to produce graduates with the necessary critical thinking skills and breadth of knowledge. Application of constructivist learning approaches provide opportunities to advance educational outcomes by leveraging the power of social connection within the learning environment. Therefore, this discussion of peer teaching strategies may facilitate the increased implementation of active learning in the context of STEM education.

203 - KNEE GAPPING FOLLOWING ANTEROMEDIAL LIGAMENT SECTIONING: A KINEMATIC APPROACH

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Introduction: The knee is constrained by soft tissue structures in and around the joint, including the medial and lateral collateral ligaments and the cruciate ligaments which connect the distal femur to the proximal surface of the tibia. Further constraint is provided by the medial and lateral meniscus and musculotendinous structures that cross the joint line. Injuries to these structures are common and may lead to instability and altered biomechanics of the knee. Such injuries are often surgically repaired or reconstructed to avoid instability and related complications. While the mechanical roles of these structures are well studied, an additional supporting structure, the anterolateral ligament (ALL) has recently been described. In this study we

investigate a previously undescribed structure in the anteromedial region of the knee, termed the anteromedial ligament (AML). We hypothesized that this structure stabilizes the knee against external rotation forces. **Methods:** Dissection was carried out on sixteen fresh-frozen human cadaveric knees. The AML was identified in each knee. The medial collateral ligament (MCL) was released from its insertion to access the AML. The femoral origin and tibial insertions of the AML were marked with 1.6mm Kirschner wires for optical motion tracking. Thirty-six tracking points were marked across the medial femur and knee. After potting, the femoral side was clamped into a static testing stand. Optical tracking data was recorded with the tibia internally rotated, externally rotated, and at neutral rotation at both 90 degrees of flexion and at full extension. Five newton-meters of torque were applied during internal and external rotation. These measures were repeated after sectioning the AML. A 3D point cloud was generated from the tracking data, and the distance between the origin and the insertion of the AML was measured in each of the 6 positions. This was used to determine the laxity of the joint before and after sectioning of the AML. Values were compared using a right-tailed t-test. **Results:** The average age of the specimens was 76 years, including 12 males and 4 females. The average length of intact AMLs was 45.1mm. Following sectioning, the length of the AML was significantly increased in flexion and extension in neutral rotation ($p=0.010$, $p=0.049$, respectively) and in flexion with external rotation ($p=0.002$). Additionally, there was significant lengthening along the MCL axis in flexion with neutral rotation($p=0.034$) and flexion with external rotation ($p=0.005$). **Conclusion:** This investigation has demonstrated that a previously undescribed structure about the knee, so called the anteromedial ligament, contributes to the soft tissue constraint of the knee joint. While degree to which this structure supports knee biomechanics is not yet known, further study may reveal that surgical repair of the AML improves knee mechanics and functionality.

204 - ACROMIOCLAVICULAR JOINT RECONSTRUCTION: A BIOMECHANICAL COMPARISON OF A NOVEL HYBRID SUTURE TECHNIQUE

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Purpose: A variety of fixation methods exist for repair and reconstruction of acromioclavicular (AC) joint injuries. Minimally invasive techniques including the TightRope® (TR) and Dog Bone® (DB) systems (Arthrex, Naples, FL, USA) are commonly used. However, postoperative complications including suture loosening and button migration resulting in loss of reduction, fracture, instability, and poor clinical outcomes have been reported. **Methods**: This biomechanical cadaveric investigation was completed to both introduce a novel suture configuration (Hybrid) and compare it with the TightRope® and Dog Bone® systems. The TightRope® system consists of two titanium buttons connected to a continuous loop of #5 FiberWire® (Arthrex, Naples, FL, USA). In the Dog Bone® system, multiple FiberTape® (Arthrex, Naples, FL, USA) or TightRope® sutures are independently attached to two titanium buttons. The Hybrid implant utilizes a combination of these systems, including the #5 FiberWire®, two FiberTapes®, and the two Dog Bone® buttons. This study utilized 24 cadaveric specimens, consisting of the scapula, clavicle, and proximal humerus. Specimens were equally and randomly allocated to one of three cohorts (TR, DB, or Hybrid), skeletonized, potted in an aluminum box, and stabilized with an aluminum rod. A board-certified, sports medicine fellowship-trained orthopaedic surgeon then implanted the corresponding implant. Following specimen conditioning, biomechanical testing, including both sinusoidal cyclic loading between 20N and 70N for 1,000 cycles in the craniocaudal direction and assessments of peak failure load, were completed with an Instron 8874 biaxial servo-hydraulic fatigue testing system (Instron, Norwood, MA, USA). Clavicular displacement was measured using a high-frequency triangulation laser distance sensor (LMI LDS-80/10M) (LMI Technologies, Burnaby, BC, CA). Device stiffness was calculated by interpolating the load and clavicle displacement values. After biomechanical testing, the distal ends of the clavicles were removed to undergo scanning with micro-CT to analyze bone density and hole widening. **Results:** All three cohorts included 8 specimens. The peak failure loads of the TR, DB, and Hybrid configurations were 473.52 ± 199.77, 487.58 ± 287.05, and 441.26 ± 215.91, respectively ($p=0.923$). Coracoid button pull-through was the most common cause of failure, accounting for 75% of failures in the TR and DB cohorts and 100% of failures in the Hybrid configuration. The three configurations had similar clavicular displacement in the first and last cycles, as well as similar differences in displacement ($p=0.759$, $p=0.218$, $p=0.395$, respectively). The TR configuration had the least clavicle displacement difference (0.48 mm $\pm$ 0.34). The three configurations did not differ significantly in stiffness ($p=0.216$) change in superior clavicle hole and drill bit ellipse area ($p=0.833$), superior clavicle hole mean bone density ($p=0.442$), and mean bone density of the entire clavicle (0.970). **Conclusion:** The Hybrid suture configuration is a non-inferior, biomechanically acceptable alternative technique to the TightRope and Dog Bone systems.

205 - SMALL EXTRACELLULAR VESICLES IN DNA HYDROGELS TO IMPROVE DIABETIC WOUND HEALING

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Diabetes mellitus is a prevalent and serious chronic metabolic disorder. For diabetic patients, the current treatment faces great challenges due to a long recovery period after skin tissue damage. In this study, we utilized the restoration capability of mesenchymal stem cell-derived small extracellular vesicles (MSC-sEVs) as well as the antimicrobial molecules to facilitate skin repair. In detail, an innovative ultrasonic spray method was developed for the large-scale production of MSC-sEVs. To realize the synergistic skin-repairing effects, MSC-sEVs were further encapsulated in DNA hydrogels to enable controlled release during the long wound-healing period. A miR-322 knockout model was further developed to explore the underlying mechanisms of diabetic wound healing in this system. Our innovation provides a new strategy for diabetic tissue regeneration.

206 - INTEGRATING BIOMEDICAL INNOVATION AND REPRODUCTIVE HEALTH EDUCATION: A HYDROGEL-CENTERED INTERVENTION FOR ASPIRING HEALTHCARE PROFESSIONALS

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Hydrogels, which are three-dimensional polymer networks capable of absorbing large volumes of water, are emerging as transformative biomaterials in regenerative medicine due to their high biocompatibility, biodegradability, and ability to mimic the natural extracellular matrix. Despite increasing study and application in areas like drug delivery, wound healing, and tissue engineering, their potential in reproductive health, especially in treating conditions such as intrauterine adhesions (IUA), premature ovarian failure (POF), and infertility caused by surgical scarring or endometrial damage, remains underexplored in medical education.

This study aims to determine whether a targeted educational intervention can improve understanding of hydrogel-based therapies among pre-health undergraduate students and pre-clinical medical students interested in obstetrics and gynecology. Our hypothesis is that targeted instruction incorporating normal and pathological reproductive physiology, along with case-based examples of hydrogel therapies, will significantly enhance biomedical literacy and therapeutic awareness in this niche area. Educational sessions will include simplified visuals of reproductive anatomy, disease models, and hydrogel mechanisms, followed by pre-/post-assessments and optional reflective feedback to evaluate knowledge acquisition. We expect to see increased awareness of how biomaterials are being translated into clinical tools to repair endometrial damage, support fertility preservation, and deliver localized therapies. We also anticipate an improved comprehension of hydrogel mechanisms, applications, and limitations, which could help fill gaps in biomedical literacy at the undergraduate and early medical education levels. This initiative could contribute to bridging the disconnect between bioengineering advances and clinical application in reproductive health by equipping future healthcare professionals with foundational knowledge of emerging biomedical technologies.

207 - ULTRASOUND-RESPONSIVE SONOSCAFFOLDS FOR REMOTE CONTROL OF CELL SIGNALING

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As advanced biofabrication techniques allow engineered tissues to become increasingly spatially complex, there is also a critical need to orchestrate the temporal complexity of cell behavior within these tissues. Advances in disease modeling and regenerative medicine require the ability to direct cellular processes within these structures after fabrication and throughout their maturation. A key strategy to achieve this direction involves modulating protein expression in select cells via targeted gene delivery within 3D scaffolds. However, conventional gene delivery methods face significant challenges in enabling remote, dynamic genetic control within fully formed biofabricated tissues. To address this challenge, our team has developed ultrasound-responsive cell culture platforms, known as SonoScaffolds, that enable noninvasive, spatiotemporally controlled genetic manipulation within 3D tissue constructs. Our approach leverages focused ultrasound as an external, noninvasive trigger to initiate biomaterial-mediated gene delivery. Ultrasound offers unique advantages as a targeting stimulus, including deep tissue penetration and precise spatial targeting to small volumes within tissue.

Our work demonstrates the utility of SonoScaffolds for controlled, localized delivery of multiple genes in user-defined regions within hydrogel scaffolds, including

spatially patterned expression of vascular growth factors. Additionally, we show ultrasound-inducible overexpression of the HER2 oncogene in individual cells within breast epithelial spheroids, enabling the study of early-stage interactions between oncogene-overexpressing cells and the surrounding healthy cells. We are also advancing this approach to create vascularized constructs and organ-on-chip models for studying crosstalk between early-stage tumors and the vasculature. To create more spatially complex tissues, we are also developing ultrasound-responsive scaffolds with intricate 3D architectures by formulating SonoScaffold materials into 3D-bioprintable inks. Using support bath-assisted bioprinting, we fabricate ultrasound-activatable hollow tubular structures embedded with cells. Within these printed constructs, transfection can be selectively triggered by focused ultrasound, demonstrating the first cell-laden bioprinted structures engineered for ultrasound-controlled gene delivery.

As these dynamic 3D tissue systems become larger and more intricate, there is also a growing need for non-destructive tools to monitor cell state within these structures. To address this, we are developing "sentinel" technologies, including optical metabolic nanosensors and microwave-assisted immunofluorescence staining tailored for 3D cultures. Together, this work introduces a new class of 3D-programmable cell culture systems that allow researchers to modulate and monitor cell behavior over time, with significant applications for both disease modeling and tissue engineering.

208 - ADVANCING OSTEOARTHRITIS PAIN TREATMENT WITH SALVIANOLIC ACID DERIVATIVES

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Osteoarthritis (OA) is a chronic degenerative joint disease characterized by cartilage degradation, inflammation, and persistent pain. Conventional treatments primarily focus on symptom management rather than addressing the major underlying damage. Natural phenolic compounds have been used to treat a variety of diseases throughout centuries. Salvianolic acid B (SB) has indicated promising approach to OA treatment due to its ability to eliminate excessive ROS and stimulate osteogenesis. The objective of this study is to manage OA by using delivery of SB into the intraperitoneal. The effects of SB are measured using a Rat OA model while inducing OA into the rats using a papain enzyme. The study examines pain management through a series of thermal and mechanical models such as dynamic weight-bearing, rotarod, vonfrey, and hotplate. Furthermore, inflammatory markers such as TNF-α and IL-6 are also measured. The findings highlighted that SB treatment on papain-induced OA significantly reduced inflammatory markers, enhanced joint mobility, and improved pain relief. This suggests the potential of SB treatment in OA and pain management.

209 - TG-ME-2: AN AI-DRIVEN PIPELINE FOR HIGH-PRECISION ANALYSIS OF SPATIAL TRANSCRIPTOMICS IN HUMAN DISEASE

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We present TG-ME-2, the second-generation version of an AI-based computational pipeline developed to analyze spatial transcriptomics datasets with exceptional precision, scalability, and biological relevance in the study of human disease. TG-ME-2 integrates state-of-the-art deep learning models, including transformer architectures and variational autoencoders, enabling a spatially resolved interpretation of gene expression patterns, cell-cell interactions, and the dynamic architecture of the tissue microenvironment across complex pathological contexts.

The pipeline has been successfully applied and validated in multiple high-impact research studies, demonstrating its versatility across diverse biological systems and disease settings. In oncology, TG-ME-2 has enabled deep profiling of the tumor microenvironment in non-small cell lung cancer, uncovering spatial patterns of immune infiltration and epithelial remodeling. In infectious disease research, the pipeline has revealed cellular and molecular heterogeneity within fatal COVID-19 lung tissue, elucidating disease trajectories and immune dysfunction through spatial single-cell transcriptomics. In neurovirology, TG-ME-2 has been employed to map the spatial distribution of Zika virus infection in the developing mouse brain, highlighting spatially distinct host-virus interactions with developmental implications.

These applications underscore TG-ME-2's ability to identify disease-specific spatial signatures, delineate functional cellular niches, and uncover molecular pathways critical for understanding disease mechanisms. The platform's analytical depth, modular architecture, and compatibility with various spatial omics technologies position it as a powerful tool for advancing systems-level insights into human pathology.

TG-ME-2 represents a significant advancement in the field of spatial transcriptomics and AI-driven biomedical research, providing a robust and generalizable framework for dissecting complex biological phenomena and supporting translational efforts in precision medicine.

210 - BALANCING ACT: A CAREER IN ACADEMIA

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This abstract describes my contribution to the planned Career Development panel geared towards undergraduate and graduate students from the broader spectrum of life science and technology at the Southern Biomedical Engineering Conference. I have a Bachelor's degree in pharmacy and a Master's in pharmaceutical chemistry from Cairo University, Egypt, and a PhD in pharmaceutical sciences. Currently, I serve as an associate professor at The University of Texas at Tyler, where I run an externally funded lab focused on drug discovery and development. I want to contribute to the Career Panel by sharing my expertise in developing a successful academic career. I will discuss with the participants strategies that I implement to achieve the three pillars of teaching, research, and service in academia. I will also share life experiences, including maintaining an environment of well-being and having a healthy work-life balance. The discussion will offer opportunities for self-development and career advancement to benefit the audience.

211 - NEW BENZOFURAN-PYRAZOLE-BASED COMPOUNDS AS PROMISING ANTIMICROBIAL AGENTS: DESIGN, SYNTHESIS, DNA GYRASE B INHIBITION, AND IN SILICO STUDIES

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The alarming rise in antibiotic resistance has created an urgent need for novel antimicrobial agents, prompting this study to design, synthesize, and evaluate new benzofuran-pyrazole-based compounds for their antimicrobial, antioxidant, and anti-inflammatory properties. The target compounds were synthesized via the Vilsmeier-Haack reaction and other chemical methods, with their structures confirmed through microanalytical and spectral analyses. Antimicrobial screening against various bacterial and fungal strains revealed that compounds 9, 10, and 11b-d exhibited significant broad-spectrum activity with MIC values ranging from 2.50 to 20 μg/mL. Antioxidant evaluation using DPPH-free radical scavenging assays showed compounds 4, 6, 9, 11b, and 11d to be particularly effective, demonstrating scavenging percentages between 84.16% and 90.52%, while HRBC membrane stabilization assays indicated strong anti-inflammatory effects for most compounds, with stabilization percentages ranging from 86.70% to 99.25%. Further investigation of DNA gyrase B inhibition identified compound 9 as a standout candidate, exhibiting potent inhibition of E. coli DNA gyrase B with an IC50 of 9.80 μM—comparable to ciprofloxacin. These results collectively highlight benzofuran-pyrazole hybrids, particularly compound 9, as promising multifunctional antimicrobial agents worthy of further development for potential clinical applications.

212 - BIOLOGICAL AND ENVIRONMENTAL IMPLICATIONS OF USING WASTE GLASS POWDER AS CEMENT AND SAND REPLACEMENT IN CONCRETE

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The disposal of non-biodegradable waste materials such as glass poses a significant threat to environmental and human health. This study explores the sustainable reuse of waste glass powder (WGP) as a partial replacement for cement and natural sand in concrete, focusing not only on mechanical performance but also on the broader environmental and biological benefits.

Concrete mixtures were formulated using three water/cement (w/c) ratios (0.45, 0.55, 0.65) with WGP replacing cement at 0%, 10%, and 15%, and sand at 0%, 25%, 50%, and 75%. Compressive strength tests conducted at 28 days revealed that while cement replacement with WGP reduced strength, sand replacement improved performance, especially at higher substitution ratios. Optimal results were observed at a 0.45 w/c ratio with 75% sand replacement, effectively compensating for strength loss due to lower cement content.

Beyond mechanical outcomes, this substitution strategy offers critical environmental and public health advantages. Cement production is a major contributor to CO_2 emissions and particulate air pollution, both of which have established links to respiratory and cardiovascular diseases. Replacing a portion of cement with WGP reduces these emissions and limits occupational exposure to cement dust. Additionally, the reuse of glass waste minimizes landfill usage and associated soil and groundwater contamination risks, thereby mitigating long-term ecological and biological hazards.

This study highlights a promising pathway for integrating industrial waste into construction materials in a manner that aligns with both structural requirements and human health goals. The findings support broader adoption of waste-derived materials as an integral part of green building initiatives aimed at fostering a healthier built environment.

213 - NANOMEDICINE FOR CANCER THERAPY: FROM DRUG DELIVERY TO POORLY VASCULARIZED TUMORS TO PROTECTION FROM RADIOTHERAPY INDUCED DAMAGE IN THE SKIN

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Based on their dimensions, nanomedicines can be designed to bridge between processes on molecular and cellular scales in the disease microenvironment. Moreover, novel RNA-based therapies require packaging into nanoparticles to protect the sensitive payload from degradation and enable their efficient delivery. Thus, nanomedicine offers unique and promising advancements in various clinical fields.

This talk will focus on the therapeutic benefits of nanoparticles targeting immune cells in the proximity of poorly vascularized tumor lesions to advance cancer therapy as well as novel mRNA based nanotherapies for wound healing and protection from radiation-induced damage in the skin.

214 - AI-GUIDED DISCOVERY OF BRAIN-PENETRANT DUAL HER2/VEGFR2 INHIBITORS FOR TARGETED THERAPY OF BREAST CANCER BRAIN METASTASES

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Brain metastases (BMs) from HER2-positive and triple-negative breast cancers (TNBC) present a major therapeutic challenge due to limited blood-brain barrier (BBB) permeability, resistance-associated HER2 mutations (e.g., L755S, T798I), and VEGFR2-driven angiogenesis. To overcome these barriers, we employed an integrated strategy combining medicinal chemistry, artificial intelligence (AI)-guided drug design, and pharmacokinetic modeling to develop dual HER2/VEGFR2 inhibitors with enhanced BBB penetration and therapeutic efficacy in the central nervous system (CNS).

We designed and synthesized a library of 215 quinazoline and pyrrolotriazine derivatives targeting HER2 and VEGFR2. Lead compounds such as HA17 and HA149 demonstrated potent antiproliferative activity against HER2+ and TNBC models, while HA47 and HA46 achieved sub-nanomolar VEGFR2 inhibition and robust antiangiogenic effects. In vivo, HA46 combined with sorafenib achieved 58.2% tumor growth reduction in HepG2 xenografts with minimal toxicity.

AI-driven tools accelerated lead optimization by predicting BBB permeability, efflux liability, and ADME/Tox properties. In vitro PAMPA-BBB assays and computational models confirmed high CNS penetration potential for key candidates (e.g., HA149, HA19). Additionally, in silico pharmacokinetic modeling informed rational optimization of physicochemical properties such as lipophilicity, molecular weight, and hydrogen bonding to favor CNS exposure.

This work establishes a novel class of dual-targeted, brain-penetrant kinase inhibitors with therapeutic promise for treating breast cancer brain metastases. By integrating AI-guided design with rational medicinal chemistry, we deliver a translationally relevant platform for advancing targeted therapies against CNS malignancies and drug-resistant tumors.

215 - ROLE OF MECHANICAL IMPACT ON THE INJURY RISK OF NEURAL CELLS

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Recent studies indicate that neuronal cells undergo morphological changes in response to mechanical stress, including alterations in cellular junctions and cytoskeletal remodeling. However, the quantitative understanding of how these cells respond to varying mechanical loads remains limited. Although mechanical forces can act on cells from multiple directions, most laboratory investigations have focused primarily on shear or stretch-type loading conditions. The objective of this study is to quantify neuronal cell responses to varying magnitudes of acceleration and to identify the loading direction that results in significant cellular injury. To explore these effects, we conducted in vitro experiments using cultured human neuronal cells (SH-SY5Y). For lateral (side) mechanical loading (SL), a spring-loaded cylindrical bar was employed to deliver controlled acceleration, while a drop tower setup was used for vertical (top) loading (TL). Cell morphology and injury were assessed using live/dead fluorescence staining. We applied acceleration levels ranging from 10g to 500g, which spans the spectrum from non-injurious to lethal based on existing literature, and monitored cellular changes for up to 30 minutes post-impact. Fluorescent imaging was performed, and analysis was conducted using BZ Analyzer and ImageJ software. This study aims to enhance our understanding of the biomechanics underlying brain injury by examining the effects of different mechanical loading directions, ultimately contributing to improved strategies for the prevention and management of traumatic brain injury and its associated complications.

216 - PREDICTING NITROGEN DIOXIDE POLLUTANT LEVEL FOR THREE CITIES USING SATELLITE DATA

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Accurate and timely information on nitrogen dioxide (NO_2) concentrations is vital for air-quality management and public health. NO_2, emitted predominantly by vehicles, power plants, and industrial activities, can worsen respiratory diseases and reduce lung function. Ground-based monitoring stations offer precise measurements but are limited in spatial coverage and expensive to install. Satellite sensors, such as Sentinel-5P TROPOMI, provide daily global NO_2 column observations, yet converting these data into reliable ground-level predictions is challenging due to complex atmospheric transport and surface interactions.

In this study, we developed an improvised deep-learning model to forecast ground-level NO_2 using daily tropospheric NO_2 columns from Sentinel-5P coupled with environmental variables—normalized difference vegetation index (NDVI), enhanced vegetation index (EVI), land surface temperature, humidity, and wind speed—sourced via Google Earth Engine. We focused on three large U.S. metropolitan areas: Los Angeles-Long Beach-Anaheim (centered at 34.05° N, 118.25° W), New York-Newark-Jersey City (40.71° N, 74.01° W), and Chicago-Naperville-Elgin (41.88° N, 87.63° W). Each city's study domain covered roughly a 50 km × 50 km area, gridded into 64 × 64 cells. For each day between January 1, 2022, and December 31, 2024, we generated a "data snapshot" by stacking the NO_2 column map and the five auxiliary layers for every grid cell—yielding 2,700 snapshots per city. We cleaned the data by removing cloudy pixels, aligning timestamps across layers, and normalizing values to ensure consistent input ranges. Ground-truth labels were obtained from 60 EPA Air Quality System monitoring stations (approximately 20 per city), producing around 65,700 station-day observations over the three-year period.

The model architecture combined a spatial encoder and a temporal decoder. The spatial encoder was a convolutional neural network (CNN) with optimized hyperparameters, that transformed each daily snapshot into a 128-dimensional feature vector. To capture temporal patterns, these feature vectors from successive days were fed into a two-layer long short-term memory (LSTM) network with 64 hidden units per layer. The LSTM learned how spatial features evolved over time and produced next-day NO_2 forecasts for every grid cell. We trained the hybrid CNN-LSTM using a 70-15-15 split to reserve for validation and testing. On the test set, the model achieved a root-mean-square error (RMSE) of 1.35, a mean absolute error (MAE) of 1.12, and explained 87 percent of variance ($R^2 = 0.87$). These results represent a significant improvement over both a random forest baseline ($R^2 = 0.78$) and an LSTM-only model ($R^2 = 0.63$), to compare our method with previous work by other authors. Integrated gradients analysis identified NDVI, EVI, and land surface temperature as the most influential predictors. A comparative analysis among the three cities was also performed, but significant local variations were not found.

Future work will extend this framework to additional pollutants, integrate emission inventories and traffic data, explore transfer learning for data-sparse regions, and assess model interpretability and robustness.

217 - SUBSTITUTED PIPERIDINES (A4)3(B2)2 NICOTINIC ACETYLCHOLINE RECEPTOR POSITIVE ALLOSTERIC MODULATORS: IN VITRO PHARMACOLOGY

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Nicotinic acetylcholine receptors (nAChRs) play a crucial role in the pathogenesis of neurodegenerative diseases such as Parkinson's disease (PD). In PD, degeneration of dopaminergic and cholinergic neurons impairs neurotransmitter release, leading to cognitive and motor dysfunction. Current treatments provide only symptomatic relief, highlighting the need for novel therapeutic strategies. The $(\alpha4)_3(\beta2)_2$ subtype of nAChRs is expressed on affected neurons, making it a promising druggable target for enhancing neurotransmitter release and providing neuroprotection. To explore the therapeutic potential of positive allosteric modulators (PAMs) of $(\alpha4)_3(\beta2)_2$ nAChRs, we evaluated chemical derivatives of CMPI [3-(2-chlorophenyl)-5-(5-methyl-1-(piperidin-4-yl)-1H-pyrazol-4-yl)isoxazole]. We used two-electrode voltage-clamp recordings from Xenopus laevis oocytes expressing nAChRs with defined subunit compositions to screen new derivatives for PAM activity and to construct dose-response curves for lead compounds. We also evaluated the in vitro cytotoxicity of the CMPI derivatives using the MTT assay. Our results thus far establish that substitutions at the pyrazole ring of CMPI (e.g., to a thiazole in A12a or an imidazole in A12c and A12e) are tolerated within the α4-α4 binding pocket and maintain selectivity for $(\alpha4)_3(\beta2)_2$ (EC_{50} for potentiation < 1 μM) over $(\alpha4)_2(\beta2)_3$ nAChRs. In contrast, modifications at the piperidine ring (e.g., to piperazine derivatives in GAT2227-GAT2230) are less tolerated, resulting in reduced or no PAM activity. Cell toxicity assays using HEK cells expressing α4β2 nAChRs showed no toxicity of the CMPI derivatives at concentrations that potentiate $(\alpha4)_3(\beta2)_2$ nAChRs. Among these, A12c exhibited no effect on cell viability at

concentrations up to 100 μM. The mode of binding for CMPI derivatives was investigated using computer-simulated docking and site-directed mutagenesis, which confirmed the extracellular. α4-α4 subunit interface as a potential binding site and identified key interactions between PAMs and amino acid residues. This study provides further evidence supporting the potential of PAMs acting at the α4-α4 interface as a strategy to selectively target the $(\alpha4)_3(\beta2)_2$ nAChR, a major subtype in the cortex. CMPI derivatives are currently being investigated in a PD-like zebrafish model, which is expected to provide evidence of in vivo efficacy and support their therapeutic potential for the treatment of neurodegenerative diseases.

218 - STRUCTURAL AND INTERFACE CHARACTERIZATION OF BIODEGRADABLE LATTICES FOR SPINAL FUSION APPLICATIONS

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Introduction: In spinal instrumentation, advanced manufacturing—especially 3D printing—has enabled greater flexibility in designing intervertebral cages and pedicle screws. Materials commonly used include titanium alloys, durable polymers like polyether ether ketone, and biodegradable options such as polylactic acid. In fusion, it is ideal to maintain stable bone contact while minimizing stress shielding by using devices with stiffness similar to surrounding bone. However, limited attention has been given to their ability to form stable bone-implant interfaces, particularly regarding lattice architecture and flexibility.

Aims/Objectives: This study aims to correlate device pull-out forces with lattice density and the resulting stiffness for gyroid and honeycomb patterns. We hypothesize that, for each pattern, there exists a density at which contact forces are maximized while preserving lattice flexibility. **Methods:** In this study, 3D-printed polylactic acid porous implants with four different densities (10%, 15%, 20%, and 25%) and two lattice patterns (gyroid and honeycomb), each with a 20 mm diameter, were tested in two phases using an Instron 8874 mechanical testing machine (Instron, Norwood, MA). In the first phase, the stiffness of the lattice structures was characterized through compression testing to a strain of 0.5% at a rate of 25 mm/min. In the second phase, similarly fabricated patterns were tested for pull-out force using an interference fit of 0.5 mm in a 15 PCF density bone surrogate (Sawbones, Vashon, WA). Each configuration was tested in four repetitions, for a total of 64 experiments. **Results:** Gyroid stiffness ranged from 59±23N/mm at 10% infill to 346±85N/mm at 25% infill. The honeycomb pattern exhibited a similar range (81±14N/mm to 389±98N/mm, $p > 0.05$). However, at 20% infill, the gyroid (179±61N/mm) was significantly softer than the honeycomb (395±79N/mm, $p < 0.01$). In terms of contact stiffness, the 10% infill gyroid (184 ± 93 N/mm) was comparable to the honeycomb (184 ± 35 N/mm, $p = 0.55$). Increasing the density from 10% to 15% resulted in significantly greater contact stiffness for both patterns ($p < 0.05$). At the highest density (25%), the gyroid exhibited significantly greater contact stiffness (612 ± 163 N/mm) compared to the honeycomb (360 ± 44 N/mm, $p = 0.01$). **Conclusions:** Our findings suggest that gyroid in the 25% infill density resulted in the highest contact stability but also greater stiffness that could hinder bone integration while lowest density lattice lacked contact stability. The compromised between contact stability and lattice stiffness was found for gyroid patterns at 20% infill density.

219 - CAN AI REPLACE A MEDICAL DOCTOR? PERSPECTIVES OF A PHYSICIAN-SCIENTIST AI TRAINER

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Artificial Intelligence (AI) is a disruptive innovation with a wide range of applications, including science, technology, and medicine. Studies show that AI is capable of synthesizing complex and limitless amounts of data within seconds. With access to the internet's vastness and every single published document, AI's accuracy improves daily. However, its infallibility is easily tested considering serious issues such as hallucinations, biases, and weaknesses in some basic areas of medicine and biotechnology. This abstract explores the extraordinary progress and pitfalls of the last few years in artificial intelligence, especially with the constant launch of new versions of large language models (LLMs).

220 - CELL-PENETRATING PEPTIDE, 30Kc19α: A PLATFORM FOR TARGETED THERAPEUTIC DELIVERY

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Cell-penetrating peptides (CPPs) are a class of short peptides, typically composed of fewer than 30 amino acids, that possess the unique ability to traverse cellular membranes. These peptides are characterized by a high content of positively charged residues such as arginine and lysine, enabling electrostatic interactions with negatively charged components on the cell surface. CPPs have garnered significant attention in recent years due to their remarkable ability to deliver a wide range of

macromolecules—including peptides, proteins, and nucleic acids—directly into the intracellular environment. Unlike traditional delivery systems that may require endocytosis or involve chemical modifications, CPPs can facilitate cellular uptake without disrupting membrane integrity, making them highly attractive for non-invasive biomedical applications. Furthermore, most CPPs demonstrate excellent biocompatibility and generally do not trigger significant immunogenic responses, positioning them as strong candidates for therapeutic development.

Among the various types of CPPs, the 30Kc19 protein derived from *Bombyx mori* (silkworm) stands out due to its multifunctionality. This protein belongs to the 30K protein family and includes an intrinsic CPP domain known as Pep-c19. Unlike synthetic CPPs or those derived from viral sequences, 30Kc19 not only facilitates cellular entry but also enhances the solubility and stability of conjugated therapeutic molecules. This dual functionality makes it especially useful for applications requiring the intracellular delivery of unstable or aggregation-prone proteins.

Importantly, a truncated form of this protein, known as 30Kc19α, represents the N-terminal α-helical domain of 30Kc19. Despite being a smaller fragment, 30Kc19α retains the key functional characteristics of the full-length protein, including its cell-penetrating ability and solubility-enhancing properties. Its reduced molecular size allows for improved efficiency in intracellular delivery, likely due to better diffusion and cellular uptake. Recent studies have demonstrated that 30Kc19α can successfully translocate into various cell types, carrying protein or peptide cargoes without inducing cytotoxic effects.

Beyond passive delivery, 30Kc19α can also be engineered for cell- or tissue-specific targeting. By fusing specific cargos, selective delivery to particular cells can be achieved. This tailored approach enables more precise therapeutic action with reduced systemic toxicity, which is particularly advantageous in treating various diseases. As such, 30Kc19α holds significant promise as a next-generation delivery vector for targeted intracellular therapy.

In summary, the cell-penetrating and cargo-stabilizing properties of 30Kc19α provide a versatile and biocompatible platform for therapeutic delivery. Ongoing research is focused on optimizing its targeting capabilities and expanding its applications in both basic research and translational medicine. This approach offers precision and safety by effectively directing therapeutic agents to specific sites.

221 - DIRECTED REACTION DISCOVERY: ACCESSING THE REMOTE SYNTHETIC LANDSCAPE

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The ability to prepare highly functionalized molecules in general and predictable ways is central to modern drug design and discovering new treatments for human disease. The aim of our program is to create new methods to solve the longstanding synthetic challenge of asymmetrically constructing biologically active small molecules. Classical synthetic approaches based on CH activations are ubiquitous but limited by the inherent directing effects of embedded heteroatoms. This presentation will discuss our recently discovered scheme to access highly basic ion pairs with organolithiums which provides a new pathway to override intrinsic heteroatom directing effects. In addition, we will describe our progress in developing new methods for carbon-oxygen bond formation reactions that utilizes primary ozonide intermediates.

222 - DEVELOPING A NOVEL SUCCINCT SYNTHETIC APPROACH TO THE MODIFICATION OF ALGINATE FOR USE IN BIOMEDICAL APPLICATIONS

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Wound healing is a complex biological process, with one of the most crucial phases being the remodeling of the tissues, which centers around the collagen present in the extracellular matrix (ECM). Degradable collagen mimics can be used to enhance and aid internal wound healing capabilities and to deliver therapeutics to local wound sites. Electrospinning natural and synthetic polymers has produced nanofibrous mats that mimic the architecture of the ECM for use in biomedical applications. Traditionally, the Hamilton lab has electrospun antimicrobial chitosan and poly(vinyl alcohol) (PVA) with novel, non-degradable collagen mimics to produce nanofiber scaffolds. Alginate, a natural polymer, can also be electrospun to produce materials for wound healing. The innate groups in alginate lend themselves towards modification to produce a biomimetic and degradable polymer that can be electrospun. Using a new concerted synthesis for the modification of alginate allows for the attachment of four functional groups via amide coupling and can be facilely conducted in an undergraduate research laboratory. This product can be oxidized to further enhance alginate degradability. The modified alginate was co-spun with PVA to create nanofibrous scaffolding. The physical properties of these materials were characterized through scanning electron microscopy (SEM) and infrared (IR) spectroscopy. Cellular responses to these alginate-based fiber mats were

examined including cell viability, proliferation, and migration. Ongoing nuclear magnetic resonance spectroscopy analysis will compare the efficiency of functional group attachments of this synthetic approach as compared to a traditional stepwise modification of this polymer. Future studies include analyzing antimicrobial properties and *in vivo* assays.

223 - DEVELOPING MODERN POLYMERIC MATERIALS FOR BIOMEDICAL APPLICATIONS

Sharon Hamilton

Ouachita Baptist University, Arkadelphia, AR

Recent evolutions in the field of biomaterials have focused on developing materials that can facilely interface with biological systems to treat or replace tissues or functions of the body. Natural polymers including polysaccharides have been investigated as suitable biomaterials to mimic the environment of body tissues and facilitate tissue regeneration. Chitosan, collagen, and sodium alginate are water-soluble, natural macromolecules that have been used in applications such as cell scaffolding, drug delivery, and wound healing. Additionally, biocompatible synthetic polymers, such as poly(acrylic acid) and polylactones, are of significant importance within the fields of tissue engineering, drug delivery, and biomedical implants. Both natural and synthetic polymers can be modified to attach biomimetic and bioactive moieties to further enhance the final macromolecular product. Electrospinning polymers yields nanofibers that have shown promise in a variety of biomedical applications, including tissue scaffolds. Modern wound healing treatments have capabilities including preventing infection and encouraging cell growth; however, little research has been published on the development of synthetic analogs to costly biomolecules. My lab investigates the development of biomimetic polymers through the modification of commercially available polymeric backbones as well as the polymerization of functionalized monomers. It is anticipated that these biomimics will prove to be suitable materials for use in a variety of applications including wound healing.

224 - ADVANCING WOUND HEALING: EXPLORING ELECTROSPUN FIBERS AND CELL CULTURE DYNAMICS

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Wound healing is a multi-billion dollar global industry that impacts millions of people worldwide. Advances in wound healing research have led to biodegradable alternatives to traditional gauze and bandages, which offer limited support for active tissue regeneration. A promising method for enhancing wound healing is electrospinning, which produces nanofibrous constructs with architectures similar to that of the extracellular matrix (ECM). For this study, sodium alginate (SA), a natural polymer shown to maintain a moist environment and exhibit biocompatibility in wounds was modified to create a bioactive and degradable alginate (oxbAlg) that mimics the functionality of collagen. Characterization of the and oxbAlg was performed via infrared and UV-Vis spectroscopy to ensure a successful functionalization and to quantify the degree of oxidation. The oxbAlg was electrospun with poly(vinyl alcohol) (PVA) that had been dissolved in $CaCO_3$ and epichlorohydrin as a cross-linker. These nanofiber mats were analyzed *in vitro* using HaCaT cells, a spontaneously immortalized human keratinocyte cell line, using a Live/Dead assay, a scratch assay, and an MTS assay conducted to assess cell viability, migration, and proliferation. Future work will be focused on testing the hemostatic capabilities of the mats as it is anticipated that these constructs will lend themselves towards a variety of biomedical applications, particularly wound healing.

225 - ANALYSIS OF THROMBIN RELEASE FROM NATURAL POLYMER-BASED NANOFIBERS TOWARDS THE DEVELOPMENT OF BIOACTIVE WOUND DRESSINGS

Gracie Moore, Sharon Hamilton

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The development of biocompatible clotting agents has been a longstanding focus of research in the medical field, as hemorrhaging accounts for 40% of all trauma-related deaths globally. Alginate is a biocompatible and biodegradable polymer that has been used in fibrous wound dressings. Calcium is an essential element in the clotting cascade that can be embedded within a variety of materials to encourage hemostasis. The Hamilton lab synthesizes an oxidized, biomimetic alginate (oxbAlg), which features functional groups similar to collagen, to enhance its functionality within the body. The oxbAlg was electrospun with other polymers and therapeutics to create biomimetic fibers embedded with thrombin and calcium ions, both of which promote blood clotting. Various crosslinking strategies were explored to enhance the physical properties of the fibers and preliminary X-ray fluorescence analysis quantified the calcium concentration within individual cut fiber mats. The release of thrombin from these fibers was analyzed via ELISA assay at specified time points. It is believed that these fibers will have an increased effectiveness in clotting assays compared to controls, including commercially available materials.

226 - ELECTRICAL AND ELECTROCHEMICAL EVALUATION OF GLASSY CARBON AND CNT-

REINFORCED GLASSY CARBON FOR NEURAL INTERFACES

Bicky Bicky Jaiswal, Umisha Siwakoti, Ashok Sigdel, Sarah Sellen[1], Sandra Zivanovic[1], Elisa Castagnola[1]

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Advancing neural interfaces requires implantable devices capable of long-term electrical and chemical monitoring. A key step toward improving flexible neural probes is the integration of materials that offer both electrical conductivity and chemical sensitivity. Carbon-based electrodes present a promising solution due to their high biocompatibility, strong sensitivity to redox-active neurotransmitters, rapid electron transfer kinetics, wide electrochemical window, and excellent stability. They are also well-suited for fast-scan cyclic voltammetry (FSCV), enabling sub-second neurochemical sensing.

Replacing conventional metal microelectrodes with carbon-based alternatives in flexible implants enables multimodal recordings, supporting both electrophysiological and neurochemical measurements. Recent developments highlight innovative fabrication strategies for carbon-based flexible neural interfaces, including boron-doped diamond and glassy carbon (GC) microelectrode arrays transferred onto flexible polymeric substrates, as well as graphene-coated metal microelectrodes formed using thermally stabilized graphene films.

Despite this progress, most devices continue to use metal interconnects alongside carbon electrodes, raising concerns about the long-term reliability of the mechanical adhesion between metal and carbon layers—particularly under electrical and mechanical stress during high-frequency FSCV. Only a few studies have reported fully carbon-based devices in which both electrodes and interconnects are fabricated entirely from homogeneous GC material on flexible substrates, and these have demonstrated exceptional electrochemical stability.

We recently demonstrated proof-of-concept for two lithography-based methods to fabricate fully GC-based devices, with both electrodes and interconnects patterned from homogeneous GC material on thin, flexible substrates. These devices achieved trace widths as narrow as 3 µm. We believe these devices can enable integrated chemical sensing and electrophysiological recording, while enhancing electrochemical durability by eliminating metal components.

However, further optimization is required to improve process control and scalability, particularly for miniaturized designs. While employing micrometer-wide GC interconnects, additional studies are needed to evaluate the conductivity and reliability of GC in highly compact architectures. In this work, we focused on evaluating GC not only as a neurochemical sensing material but also as an interconnect material.

We systematically examined the sheet resistance of GC films with varying pyrolyzed thicknesses and analyzed how interconnect geometry influences overall resistance across different film thicknesses. To enhance conductivity, we incorporated multiwalled carbon nanotubes (MWCNTs) into the SU-8 precursor, yielding reinforced CNT-GC. To support compact multilayer device development, we also investigated the effects of repeated pyrolysis cycles on the electrical properties, structural integrity, and sensing performance of both GC interconnects and microelectrodes.

Raman spectroscopy and X-ray diffraction were employed to assess graphitization, structural order, and defect density in the GC films. Additionally, we compared the serotonin (5-HT) and dopamine (DA) sensing performance of GC and CNT-GC microelectrodes fabricated using one versus two pyrolysis cycles, using FSCV to evaluate their electrochemical efficacy.

These investigations advance our understanding of GC's electrical and sensing properties, providing critical insights for optimizing compact, multilayer devices in next-generation multimodal GC microelectrode array.

227 A NON-INVASIVE DEEP LEARNING APPROACH FOR CAD DETECTION USING 1D-CNN-BASED HEART SOUND CLASSIFICATION

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This project aims to discriminate between Coronary Artery Disease (CAD) and non-CAD groups by analyzing the condition and functional patterns of heart signals thoroughly to reduce errors. Lack of attention and inadequate accuracy towards early CAD diagnosis is crucial because of leading in mortal risks for patients. A deep learning method based on Convolutional Neural Network (CNN) is proposed for classifying heart sound through Phonocardiogram (PCG) signals to avoid these critical issues in the early stages. Although many screening methods for CAD detection have been proposed, but this study relies on non-complex processing steps. This model offers high classification accuracies for 1-D time series. One-dimensional CNN is trained in this approach to detect the CAD suffered patients from healthy individuals based on their PCG signals. The classification performance results

show that the proposed network can effectively recognize patients with CAD. We also suggest this model to reduce human error in detecting CAD potentially and enhance the diagnostic accuracy. A comparison with existing studies demonstrates that the proposed deep learning model for heart sound classification is an effective non-invasive technique in CAD detection with promising accuracy results. The simplicity and efficiency of our method highlight its reliability in diagnosing CAD.

228 FRACTUREDETECT: AI-DRIVEN COMPUTER VISION FOR ACCURATE BONE FRACTURE DETECTION AND CLASSIFICATION

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This AI-powered computer vision framework was developed to detect and classify bone fractures from radiographic images automatically. Utilizing the Roboflow platform for dataset annotation, preprocessing, and model training, the system offers an end-to-end pipeline from image acquisition to deployment. A convolutional neural network (CNN)-based architecture is trained to identify fracture types such as transverse, oblique, and comminuted, achieving a classification accuracy of approximately 90.5%. Integrated with augmentation strategies and transfer learning, the model demonstrates strong generalization across diverse fracture cases. Designed for efficiency, *FractureDetect* is optimized to run on low-power edge devices in real time, making it suitable for mobile and point-of-care applications. By enabling rapid and consistent diagnostic support without the need for continuous cloud connectivity, this system offers a promising solution for clinical environments with limited radiological expertise. It emphasizes the potential of AI-driven tools in accessible and scalable healthcare delivery.

229 Enabling On-Device Automation of Low-Power Wearable Energy Management Systems

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Wearable devices have become indispensable in modern daily life, yet their limited battery life remains a significant barrier to widespread adoption. This study explores integrating various energy harvesting techniques and memristive encoders to tackle this challenge, aiming to enhance battery management and extend device longevity. This research provides a simulation analysis that illustrates the capabilities of memristors in improving non-volatile memory, which is crucial for the efficient encoding and storage of energy data, thereby optimizing battery management in wearable devices. Their programmable nature also facilitates adaptive control strategies, potentially enhancing system efficiency and sustainability. Through theoretical analysis, simulations, and experiments conducted within the confined space of a wearable device, we identified a flexible system as the optimal solution for energy harvesting. Incorporating memristive encoders further optimized battery management, enhancing device efficiency and sustainability. This research underscores the importance of considering practical limitations in energy harvesting for wearables and provides insights for future designs. By highlighting renewable energy sources and advanced battery management techniques, our study aims for sustainable and environmentally friendly wearable technology, promising prolonged device operation and reduced ecological footprint.

229 AI POWERED EARLY MORBIDITY DETECTION IN PRETERM INFANTS: AN APPLICATION TO BRONCHOPULMONARY DYSPLASIA

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Preterm infants are predisposed to multiple morbidities due to impaired cardiorespiratory function resulting from immature development. Bronchopulmonary dysplasia (BPD), is one such chronic condition that causes long term respiratory problems and occurs most often due to prolonged exposure to supplemental oxygen / mechanical ventilation leading to lung injury. BPD is clinically diagnosed only at 36 weeks postmenstrual age, and its developmental trajectory can be complicated by other conditions such as pulmonary hypertension. An earlier risk stratification or detection is hence recommended for possible interventions to avert this lung disease. Frequency and duration of intermittent hypoxemia when oxygen saturation drops below 85% in infants, has been implicated in the development of multiple morbidities including BPD. In this study, we focused on time limited oxygen saturation data (SpO_2) recorded during the first postnatal week in preterm infants, to develop data-driven models for early detection of infants who were (later) diagnosed with BPD. Using SpO_2 features extracted from 120 infants, standard machine learning classifiers as well as deep learning models were developed, and their performance assessed by cross-validation. On day 7 after birth, these models provided BPD detection accuracy around 65-75%, sensitivity 70-85%,

specificity 60-70%. Data based modeling of BPD is a promising avenue with potential for bedside implementation to support clinical decision making to support this vulnerable population.

230 EXPLORING THE THERAPEUTIC POTENTIAL OF FIBROBLAST-DERIVED EVS IN *IN VITRO* WOUND HEALING MODELS

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Extracellular vesicles (EVs) are membrane-bound nanostructures naturally secreted by several cell types, including fibroblasts, immune cells, and neoplastic cells. They facilitate intercellular communication by transporting bioactive cargo, including proteins, lipids, and nucleic acids. NIH3T3 cells are an immortalized line of mouse embryonic fibroblasts extensively utilized in biomedical research for their high proliferation and wound-healing properties. Extracellular vesicles (EVs) originating from NIH3T3 cells (NIH3T3-EVs) encompass fibroblast-specific proteins, growth factors, and extracellular matrix modulators that facilitate cell migration, proliferation, and tissue repair. Preliminary research indicates that NIH3T3-EVs can enhance fibroblast migration in scratch assays and could influence local wound microenvironments by transmitting regenerative signals. Due to their non-tumorigenic origin and regenerative properties, NIH3T3-EVs represent a promising cell-free therapeutic approach for accelerating wound closure and enhanced healing outcomes. This research study was designed to observe the wound healing process over treatment with protein-enriched NIH3T3-derived extracellular vesicles (EVs). In this pilot study, we initially isolated extracellular vesicles (EVs) from NIH3T3 cells and characterized its size and protein load. The wound healing assay is carried out by culturing NIH3T3 cells in 12-well plates. After full confluence, the wound has been created. Then the cells were treated with varying concentrations of EVs (5%, 10%, and 20% equivalent to serum protein concentration). The healing process was captured using a live cell imaging system (CytoSMART Lux3 FL) with varying doses of FBS. Time-lapse images were captured at 10-minute intervals over a duration of 72 hours. After the experiment, the wound healing kinetics were analyzed using the ImageJ software. Analysis of the wound healing data revealed that treatment with NIH3T3 cells facilitated the recovery of wound healing. Our findings demonstrate that NIH3T3-derived extracellular vesicles significantly enhance fibroblast-mediated wound healing in a dose-dependent manner, supporting its regenerative potential *in vitro*. In future, we intend to examine the specific protein cargo to identify key molecular drivers of the healing response. Furthermore, in vivo validation and comparison with EVs produced from other cell types will be pursued to further establish NIH3T3-EVs as a promising therapeutic approach for wound healing and regenerative medicine.

231 NICOTINIC RECEPTORS IN RESPIRATORY DISEASES: INSIGHT FROM EXPERIMENTAL MODELS

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Nicotinic acetylcholine receptors (nAChRs) play a multifaceted role in the regulation of respiratory function and inflammation. This presentation will explore how nAChRs could contribute to the pathophysiology of some respiratory diseases drawing on data from diverse experimental models. We will highlight how specific nAChR subtypes, particularly the α7 subtype, modulate inflammatory signaling in the lungs. Additionally, some in vitro models will be discussed to illustrate the potential therapeutic implications of targeting nAChRs. The talk aims to provide a translational perspective on how modulation of cholinergic signaling could inform novel strategies for the treatment of respiratory disorders.

232 DEVELOPMENT OF A NOVEL SUSPENSION SYSTEM FOR A MILITARY RUCKSACK THAT REDUCES REPETITIVE STRESS INJURIES DURING RUCK MARCHING

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BACKGROUND: Musculoskeletal injuries (MSKIs) constitute 83% of all Army injuries in 2016, and lead to 2 million clinic visits and 25 million limited duty days, making them the leading cause of outpatient treatment. Rucking is a major source of these MSKIs. However, the military rucksack design has changed little over the course of the past three decades despite its implication in repetitive stress injuries in male and female warfighters. The standard issued military rucksack (Modular Lightweight Load-Carrying Equipment, or MOLLE) currently used in basic training was designed as a one size fits all frame that lacks gender specific structure. **PURPOSE:** The goal of the proposed project is to design a rucksack with an experimental suspension system (ESS) based upon previously proven technology, called the Ergonomic Backpack, which improves the loading mechanics compared to a standard-issued MOLLE rucksack during

quiet stance trunk flexion and rucking. The objectives of this project were to design and fabricate an experimental suspension system that redirects a portion of the shoulder and spine loads to the pelvic region and biomechanically compare it to a standard-issue MOLLE rucksack during simulated quiet stance trunk flexion and rucking. Three studies will be carried out: 1. Layout of an Additive manufacturing platform (AMP), 2. Quiet stance evaluation, and 3. Walking trial. **METHODS:** An additive manufacturing platform was built out for the purpose of fabricating the ESS. The additive manufacturing platform consisted of a fused deposition model (FDM) 3-D printer, white light/IR 3D scanner, and mesh editing and design software. The ESS was printed with Polymaker CoPA (Nylon), due to its high strength properties. Quiet-stance measures included shoulder load, strap tension, and trunk flexion. Walking trail measures included joint angle, net hip extensor moment, muscle activity, and metabolic measurements. The participants will perform the quiet stance evaluation under three conditions: MOLLE rucksack without hip belt secured, MOLLE rucksack with hip belt secured, and ESS. The participants will perform the walking trial under two conditions: MOLLE rucksack with hip belt secured and ESS. **RESULTS:** Through the creation of an AMP, a prototype ESS was fabricated. For study 2, shoulder and strap loads were greater for MOLLE rucksack without hip belt secured. For study 3, walking trials are underway in the gait lab. It is expected that the ESS will produce lower net hip extensor moments as compared to the MOLLE. For the MOLLE, the hip belt off condition is expected to produce higher net hip extensor moments as compared to the hip belt on. **CONCLUDING DISCUSSION:** Preliminary findings support the design concepts of ESS to offload the shoulder and spine loads.

233 EVALUATION OF A DYNAMIC ANKLE ORTHOSIS TO IMPROVE THE MANAGEMENT OF TIBIAL BONE STRESS INJURIES IN LOCAL RUNNERS: A PROPOSAL

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Tibial bone stress injuries (TBSI) are the most prevalent overuse injuries amongst military cadets (29-74%) and recreational runners (21.2%). The cyclic mechanical loading nature of running at submaximal levels degrades the mechanical properties of bone over time leading to increased strain and the development of microdamage. This phenomenon is known as fatigue, and over time as the rate of bone damage outweighs the rate of repair, microcrack propagation can lead to TBSI. Clinicians prescribe an orthopedic walking boot (WB) for daily use for 3-26 weeks. The rigid design of a WB results in reduced ankle mobility, decreased muscle activity, and muscle atrophy within 7-14 days of boot wear, delaying recovery. Our lab has developed the novel Dynamic Ankle Orthosis (DAO) as an alternative treatment solution to a WB that applies a distractive offloading force between the foot and proximal tibia while maintaining ankle mobility during walking. *The objective of this study is to assess how a custom DAO affects the rehabilitation outcomes in the injured and uninjured limbs of runners recovering from TBSI compared to a standard of care WB.* An estimated forty-two participants from the greater Memphis area will be recruited and randomly assigned to wear one of two orthoses: DAO or WB. Each participant will undergo follow up assessments (30-60min) every Monday and Thursday to assess their rehabilitation outcome. To determine if either orthosis has altered the sagittal and frontal ankle motion, calf muscle size, and muscle strength of the injured limb, the following parameters will be collected: (i) Plantarflexion/dorsiflexion and inversion/eversion, (ii) Calf muscle circumference measured at 66% of the tibial length, between the medial malleoli and medial tibial epicondyle (distal to proximal), (iii) A handheld surface scanner will be used to scan the lower leg and calculate the segmented volume to help quantify any changes in lower leg volume due to muscle atrophy, and (iv) Plantarflexor muscle strength using a dynamometer while performing isometric plantarflexion lying in a supine position with the participants leg positioned in ninety-degree angle. This will help provide a measure of torque output from the soleus since it is the primary muscle that bears most of the load during running. The study is expected to last 6 – 8 weeks for each participant. Every day at 7pm, the participant will receive and complete a short 5-question daily questionnaire assessing their daily step count, wear time (min), and pain level (0 = no pain, 10 = worst pain imaginable). Our research team postulates the DAO's ability to offload the lower limb while also allowing ankle mobility will be beneficial to runners during the recovery phase. The proposed clinical study will provide evidence that supports how the DAO will improve treatment outcomes and the management of TBSI in local runners. More specifically, we anticipate the DAO will minimize loss of ankle ROM, muscle atrophy, and muscle strength that normally occurs when wearing a conventional orthopedic WB. Collectively, these improvements should result in a shorter recovery time and quicker return to training compared to treatment with the WB.

234 A DYNAMIC ANKLE ORTHOSIS IMPROVED PATIENT COMFORT DURING EXTENDED WEAR

COMPARED TO AN ORTHOPEDIC WALKING BOOT

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Tibial bone stress injuries (TBSI) are common in military trainees (29-74%) and recreational runners (21.9%). Clinicians prescribe an orthopedic walking boot (WB) for daily use for 3-26 weeks. The rigid design of a WB results in reduced ankle mobility, decreased muscle activity, and muscle atrophy within 4 days of boot wear, delaying recovery. A newly developed custom Dynamic Ankle Orthosis (DAO) was designed that applies a distractive force across the lower limb that reduces vertical in-shoe force and tibial compressive force while retaining unbraced ankle motion during walking. *The purpose of the study was to assess the comfort level of the DAO during extended wear in healthy adults during daily walking activities*. Ten healthy participants (5 males, 5 females; 24 ± 4 yrs; 74.7 ± 14.8 kg; 1.76 ± 0.1 m) performed four walking activities at a preferred walking pace for two brace conditions: DAO and WB. Force sensing insoles (100Hz, loadsol, Novel) measured the shear force component on the anterior aspect of the shin in the brace condition. Participants wore each brace condition for 7 days and completed daily surveys. Preliminary results demonstrated that the DAO largely outranks the WB for acute comfort ($r > 0.5$, $p < 0.05$) and functionality scores ($r > 0.5$, $p < 0.05$) across four walking tasks: (i) overground walking (without an obstacle), (ii) overground walking (with an obstacle), (iii) timed up-and-go, and (iv) walking circuit meant to simulate a real world environment. There was a fifty percent drop in patient comfort for the WB compared to only thirty percent for the DAO relative to the normal no brace walking condition. Similarly, the DAO demonstrated a fifteen to twenty percent drop in functionality or ease of performing each walking task whereas the WB inhibited the participations ability to perform the walking tasks by forty to fifty percent. This study determined that the rigid design of the walking boot created a shear force that acted on the anterior aspect of the tibia. The results further demonstrated that this peak shear (shin) force was largely was significantly lower in the DAO ($r = 0.9$, $p < 0.05$) compared to the walking boot during overground walking. Over the 7-day extended wear period, comfort scores improved greatly for the DAO compared to the WB ($r = 0.5$, $p = 0.30$). The improved walking mechanics of the DAO observed in previous studies combined with the current findings of better acute comfort and functionality, and better extended wear comfort, suggest that the DAO may be a functional and mechanically superior option for tibial BSI rehabilitation. The anterior tibia is considered a high-risk BSI location that is often at risk for delayed, nonunion, or surgical intervention. The shear force created by the rigid design of the WB, raises the question if a WB contributes to delayed or nonunion by aggravating the patients TBSI and delaying the bone healing process? Future research will investigate the specific areas of the anterior tibia where the shear force is concentrated.

235 USE OF ADDITIVE MANUFACTURING TOOLS TO IMPROVE THE DESIGN PROCESS OF SCOLIOSIS BRACING TECHNOLOGY

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BACKGROUND: Adolescent idiopathic scoliosis (AIS) is an irregular curvature of the spine in children that develops during early adolescence. Braces are used to treat scoliotic deformities that range between 25° and 40° and have been found to be 72% effective in preventing progression of the deformity. However, the 18 hours or more recommended wear time has reduced brace wear compliancy and therefore brace effectiveness. Further, conventional bracing technology uses Velcro strap fasteners that are reported to loosen over time. The current manufacturing process for braces begins with using a 3D scanner to obtain a scan of the patient's upper torso. The scan data are processed through computer aided design (CAD) software to create a model of the upper torso, which is used to create a patient specific brace model with relief cutouts. Computer aided manufacturing (CAM) software is utilized in conjunction with robotic machining to fabricate a physical foam mold of the brace. Thermoplastics are thermoformed around the mold to create the physical brace that will be worn by the patient after the Velcro strap fasteners are added by an orthotist. Recently, articles have been published where the conventional brace is scanned and 3D printed. These studies have shown that 3D printed conventional braces using Velcro strap fasteners produce the same Cobb angle correction of the scoliotic spine as traditionally manufactured braces. The Biorobotics and Rehabilitation Lab at UTHSC has developed an alternative fastening system comprised of constant tension units (CTUs) that maintain strap tension and apply active force correction to the spine. It is hypothesized that active strap loads will

maintain or reduce the spinal curvature, improve brace comfort, and extend brace wear compliancy. **PURPOSE:** To use additive manufacturing tools to improve the design process of scoliosis bracing technology. Two design tasks were undertaken: 1. Fabrication of custom fixed CTU holders that fit into an existing scoliosis brace and 2. Design of a flexible, lightweight, and breathable scoliosis brace with integrated CTU devices in strategic locations. **METHOD:** Steps in the design process included: 1. Scanning the pre-fabricated scoliosis brace of a patient and/or their upper torso with a 3D scanner, 2. Using modeling and CAD software to create 3D models of the custom CTU holders or patient specific brace, and lastly 3. Fabricating the custom brace and brace components on a 3D printer. **RESULTS:** Custom fixed CTU holders were made that easily fit into the body of an existing scoliosis brace. Steps are underway to design and fabricate a patient specific brace with integrated CTU devices. **CONCLUDING DISUCSSION:** We anticipate that use of these additive manufacturing tools will result in an improved design process for manufacturing scoliosis braces.

236 Novel nanoparticle-based approaches to overcome longstanding limitations of T cell-based cancer immunotherapy.

Kareem Azab, Department of Biomedical Engineering, UT Southwestern Medical Center, Dallas, TX.

CAR-T and bispecific T-cell engager (BTCE) therapies have transformed cancer treatment, but both face significant limitations that constrain their broad clinical impact. CAR-T therapy is limited by manufacturing complexity, high cost, and the need for patient-specific cell engineering, which delays treatment. Many patients relapse due to antigen escape—loss or downregulation of the target antigen. BTCEs are "off-the-shelf" and avoid lengthy manufacturing, but their short serum half-life (especially for small BiTE molecules, a half-life of a few hours) necessitates continuous infusion for sustained activity. BTCEs also share antigen escape as a major resistance mechanism. Both modalities require improved antigen selection strategies to overcome antigen escape to prevent immune evasion, and innovations to enhance PK for more durable responses.

We have developed a novel class of immunotherapeutic agents: nanoBiTEs and nanoMuTEs. NanoBiTEs are liposomal nanoparticles decorated with monoclonal antibodies targeting both CD3 (on T cells) and a single cancer-associated antigen, facilitating T-cell engagement and tumor cell killing. While, nanoMuTEs enhance this design by conjugating multiple tumor-targeting antibodies alongside anti-CD3, enabling simultaneous engagement of several cancer antigens.

A key innovation lies in their significantly extended half-life—approximately 60 hours—compared to the typical ~2-hour half-life of conventional BiTE molecules. This extended pharmacokinetic profile enables comfortable once-a-week administration rather than continuous infusion, significantly improving patient convenience and potentially reducing infection risks associated with long-term infusion.

NanoBiTEs showed outstanding efficacy in eradicating tumors with highly expressed unique antigens such CD3xCD20 NanoBiTE for the treatment of low grade lymphomas, and CD3xCD33 NanoBiTE for the treatment of AML, both using in vitro and in vivo models. Moreover, nanoMuTEs, by engaging multiple antigens, demonstrated superior efficacy in multiple myeloma models in vitro and in vivo when compared to mono-specific nanoBiTEs. Importantly, nanoMuTEs did not induce antigen loss neither enable antigen-negative tumor escape, a common limitation seen with therapies targeting a single antigen.

In summary, this modular liposomal T-cell engaging platform offers a promising solution to key challenges of current T-cell immunotherapies—enhancing efficacy, ensuring durability, and overcoming antigen heterogeneity, and antigen-less tumor escape.

237 CHEST ULTRASONOGRAPHY AS A TOOL FOR MEASUREMENT OF PLEURAL EFFUSION: A PRECLINICAL STUDY OF EMPYEMA IN RABBITS

E.V. Bailey, C.J. De Vera, J. Jacob, K. Sarva, S. Christudas, O. Akiode, A.A. Komissarov, A.O. Azghani, S. Idell and G. Florova

Introduction: Pleural empyema is a condition where pus forms within the pleural space, often due to severe pneumonia. Treatment of empyema includes antimicrobial drugs, thoracostomy tube drainage, intrapleural fibrinolytic therapy, and surgery. Common imaging modalities for empyema include chest radiography, computed tomography (CT), and ultrasonography. In the United States, CT is often regarded as the gold standard for imaging of pleural effusion due to improved visualization of the lung parenchyma. However, since CT emits ionizing radiation, chest ultrasonography may offer a safer alternative for repeated imaging to monitor pleural effusion volumes, particularly in pediatric patients.

Given the comparable size of rabbits to pediatric patients, this model offers potential relevance for application to pediatric patients. Moreover, in medically underserved communities, CT is often less accessible than ultrasound. This study aims to assess the utility of ultrasound imaging to measure pleural effusion in a model of empyema in a rabbit.

Materials & Methods: Ultrasonographic imaging (Logiq e, R10 v1.3, GE Healthcare) was used to retrospectively assess pleural effusion volume in an early-stage and advanced-stage empyema model in rabbits. To promote pleural drainage, both models were treated with fibrinolytic therapy for 24h. Either thoracentesis or tube thoracostomy was performed at 8h and 24h to drain pleural effusion. To quantify pleural effusion, vertical distance (cm) and 2D pleural effusion area (cm^2) were measured using the R10 internal measurement tool in both axial and coronal views. All imaging measurements were taken in a standardized manner. Each of the 2D ultrasonography measurements were correlated with Actual Pleural Effusion Volume (mL) to determine the strength of association. Furthermore, a linear regression was used to determine the best-fit equation to quantify pleural effusion volume. Next, this pleural effusion volumetry tool was further validated by correlating the Predicted Pleural Effusion Volume Before Drainage (mL) with the Total Calculated Volume (mL), which was calculated as the sum of the Predicted Pleural Effusion Volume (mL) after drainage and the actual Pleural Effusion Volume (mL) drained at 8 hours.

Results: Four pleural effusion volumetry methods were evaluated: Axial view length ($p < 0.0001$, $r = 0.68$), coronal view length ($p < 0.001$, $r = 0.34$), axial view area ($p < 0.0001$, $r = 0.78$), coronal view area ($p < 0.0001$, $r = 0.76$), demonstrating that area measurements yield the best fit equation for predicting pleural effusion in vivo. According to the best fit equation, for each 1 cm_2 of the 2D area measurement on the ultrasound, there was 15.8 mL of physical pleural volume present. Additionally, both axial and coronal views demonstrated a strong positive association between the calculated pleural fluid volume and the total post-drainage volume, demonstrating the utility of ultrasonography in measuring pleural effusion efficiency ($p < 0.0001$). This indicates the validity of our model to quantify pleural fluid volume with 2D ultrasonography measurements for empyema in a pre-clinical rabbit model.

Conclusion: We have shown that chest ultrasonography is a feasible method to quantify pleural effusion volume in rabbits with empyema. These techniques can improve the imaging of our preclinical model after intrapleural interventions. We hope this approach can be applied clinically to optimize pleural effusion outcomes.

238 LIQUID CRYSTAL ELASTOMERS: ARTIFICIAL MUSCLES AND IMPLANTABLE ELECTRONICS

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Aligned liquid crystal elastomers (LCEs) respond to environmental changes by changing form in programmed manners. We see this well-known property as a tool to create implantable actuators and to deploy medical devices. For example, LCE artificial muscles may enable the treatment of stress urinary incontinence. As a soft actuator that can respond to temperatures just beyond body temperature, these materials are well-suited to manipulate soft tissues. An artificial LCE sphincter could normally help block urine flow and then be triggered by photothermal heating from an IR light to allow voiding. In a rabbit model of incontinence, the force required to cause urine leakage can be modulated by over 30% based on photothermal actuation of the LCE. We will also describe steps towards the development of a deployable intracortical array that could move microelectrode sites away from the body of the intracortical device at the center of the implantation site. It is hypothesized that this approach could eventually minimize the FBR around the microelectrode site and thus potentially improve recording quality over time. In the LCE substrate, a patterned molecular orientation is encoded by first aligning the monomers using directed self-assembly. This alignment is trapped by polymerization and encodes the type of deployment that will be observed after implantation. To enable insertion of the intrinsically 3D device in tissue, we include a photoresponsive moiety, azobenzene, allowing UV light to trigger the trans-cis isomerization of azobenzene and thus lead to the shape change. The LCE substrate morphs into a flat form when azobenzene is excited to its *cis* form by the UV light. After implantation, the azobenzene gradually transitions to its stable, *trans*, state such that deployment is 90% complete after 2 hours at 37 °C. We will also discuss the challenges that remain for LCEs as long-term implanted devices.

239 RELEVANCE OF MEDIAL WALL DEFECTS IN DETERMINING ACETABULAR STRENGTH IN TOTAL HIP ARTHROPLASTY: A PILOT STUDY ON BONE SURROGATES

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INTRODUCTION: Total hip arthroplasty (THA) is a highly successful treatment for end-stage hip osteoarthritis, with annual case volumes projected to reach nearly 600,000 by 2030. Despite its reliability, about a quarter of THAs require revision, often due to aseptic loosening of the acetabular component. Radiographic classification systems such as Paprosky and AAOS help assess acetabular bone loss but lack quantification of wall strength. Specifically, the management of Paprosky 2C defects—characterized by medial wall loss—remains controversial due to uncertainty regarding press-fit cup fixation stability. This study aims to evaluate whether a medial wall defect compromises the mechanical stability of acetabular cup fixation by

comparing stiffness and strength between an intact acetabulum and one with a medial wall defect.

METHODS: A 3D model of a cadaveric pelvis was reconstructed using Slicer 3D and imported into Fusion360 for virtual templating of a 56mm acetabular cup. Two foam bone models were machined from ASTM F1839 polyurethane foam (15 PCF) to simulate low-density bone: one representing a pelvis with an intact acetabulum (control) and one representing a pelvis with a 42mm medial wall defect (Figure 1). Mechanical testing was conducted using an Instron 8874 machine with custom fixtures to simulate acetabular expansion (Figure 2). Each configuration was tested to failure (n=5 per group), with peak force used as a measure of strength and the slope of the load-displacement curve used for stiffness. Statistical comparison was performed using a T-test of Mann-Whitney test.

RESULTS: All ten specimens failed under testing. Failure was localized at the acetabular rim in two of the models with an intact acetabulum, while failure of all the other models extended to the medial wall, compromising the integrity of the acetabulum. The peak load for the intact configuration was 1236N±166 compared to 1288N±119 for the defect model (p=0.588, Figure 3a). Stiffness values were also similar: 888N/mm±54 (intact) vs. 917N/mm±34 (defect, p=0.330, Figure 3b), indicating no statistically significant difference.

DISCUSSION: The absence of the medial wall did not significantly affect the mechanical strength or stiffness of acetabular cup fixation, supporting the hypothesis that medial wall integrity is not critical for press-fit stability. This aligns with prior findings suggesting no apical contact between press-fit cup and the medial acetabular wall. However, further studies using cadaveric specimens are warranted.

SIGNIFICANCE/RELEVANCE: This study provides quantitative data indicating that medial wall defects, such as those in Paprosky 2C defects, may not compromise cup stability. These findings offer a biomechanical rationale for continued use of press-fit cups in such cases and lay the foundation for evaluating other defect types using similar methods.

ACKNOWLEDGEMENTS: We thank Mr. Al Ogden for his assistance with mechanical testing.

IMAGES AND TABLES:

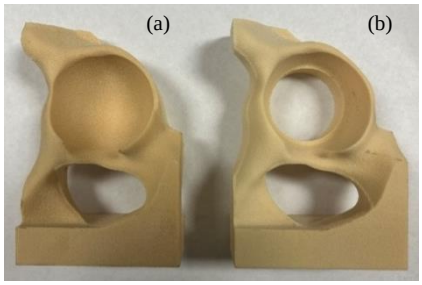

Fig 1: Configuration representing the intact acetabulum (a) and the defect model used for the study (b).

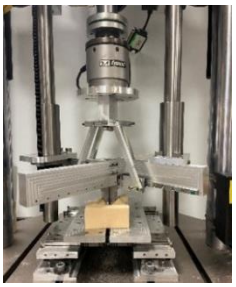

Fig 2: Custom made fixture for the Instron 8872 used to test

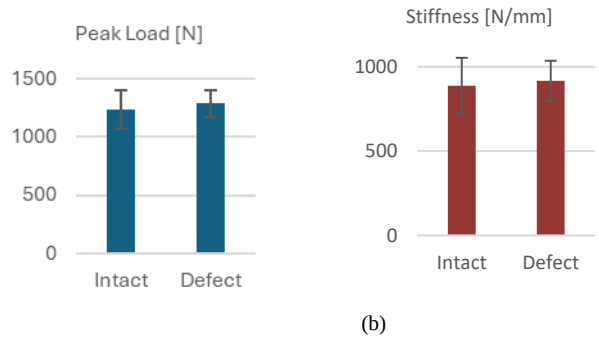

Fig 3: Experimentally obtained values of acetabular wall Strengths (a) and Stiffness (b).

240 KEYNOTE: BIOMEDICAL AND SCIENCE EDUCATION FIELDS AND THE ROLE OF FACULTY IN TRAINING THE FUTURE GENERATIONS OF SCIENTISTS

Jamil Ibrahim, PhD.
Mississippi Academy of Sciences

Biomedical and science education plays a pivotal role in preparing the next generation of researchers, healthcare professionals, and informed citizens. By integrating core scientific principles with emerging biomedical technologies, this interdisciplinary field fosters critical thinking, innovation, and a deeper understanding of human health and disease. Modern educational approaches emphasize experiential learning, interdisciplinary collaboration, and the use of digital tools such as virtual labs and simulations. Additionally, equity and inclusion are becoming central to educational reforms, ensuring diverse participation in scientific fields. As biomedical challenges grow increasingly complex—from pandemics to personalized medicine—science education must evolve to equip learners with the skills, ethics, and knowledge necessary for impactful contributions to society.
Faculty play a critical role in the advancement of biomedical science education and research by ensuring methodological rigor, promoting data-driven thinking, and

mentoring the next generation of scientists. Their contributions are particularly essential in interdisciplinary biomedical training environments, where the integration of statistical methods with biological and clinical research is foundational to evidence-based science. This abstract explores how biostatistical educators design core curricula, collaborate across disciplines, and guide both undergraduate and graduate trainees in research involving data analytics, experimental design, and clinical trials. Also, this presentation discusses structural barriers faced by minority students, such as lack of representation among faculty, implicit bias, and limited access to high-impact research opportunities. It presents evidence-based interventions that have improved success metrics, such as early STEM engagement, cohort models, research fellowships, and leadership development programs.

241 NICOTINIC RECEPTORS IN RESPIRATORY DISEASES: INSIGHT FROM EXPERIMENTAL MODELS

Carla Máximo Prado, Nathalia Montouro Menegasso, Ayman K Hamouda

Nicotinic acetylcholine receptors (nAChRs) play a multifaceted role in the regulation of respiratory function and inflammation. This presentation will explore how nAChRs could contribute to the pathophysiology of some respiratory diseases drawing on data from diverse experimental models. We will highlight how specific nAChR subtypes, particularly the α7 subtype, modulate inflammatory signaling in the lungs. Additionally, some in vitro models will be discussed to illustrate the potential therapeutic implications of targeting nAChRs. The talk aims to provide a translational perspective on how modulation of cholinergic signaling could inform novel strategies for the treatment of respiratory disorders.

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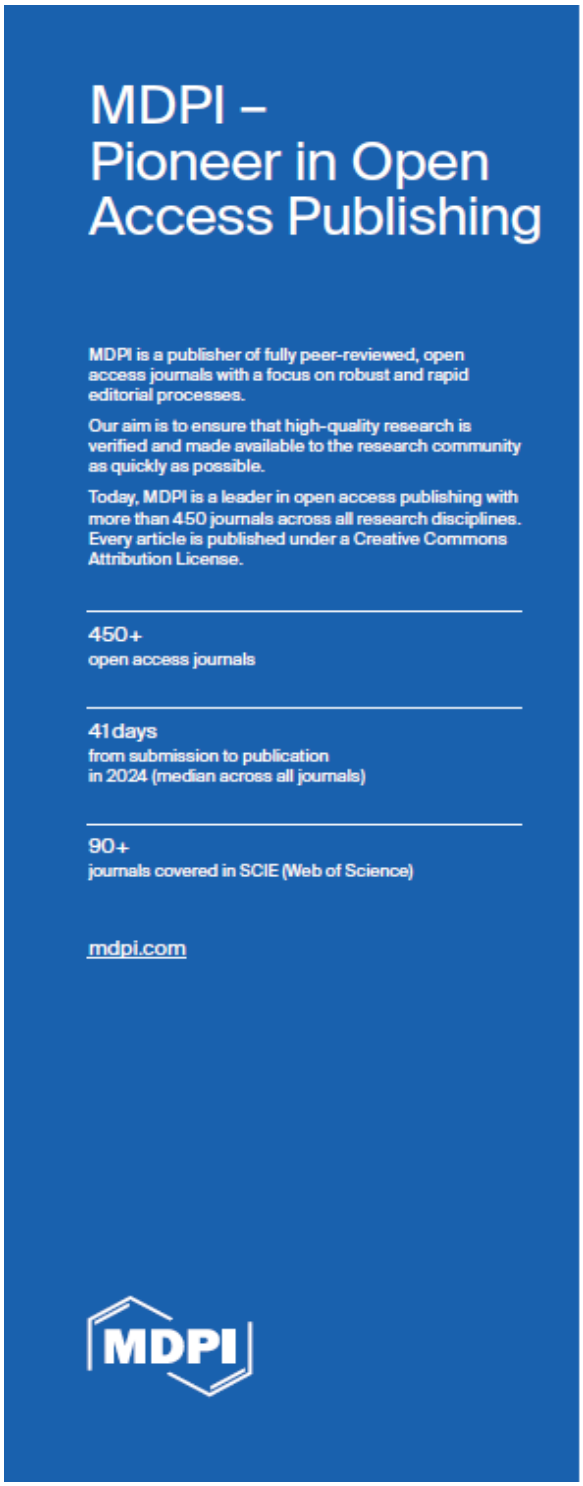
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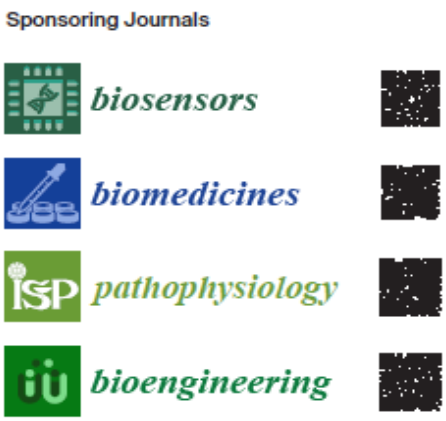
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