

FY24

Dalton Cardiovascular Research Center

*Committed to Interdisciplinary
Collaboration in Research and Teaching*



Front Image courtesy of Xiaoqin Zou, PhD

"MDock: A molecular docking software for predicting protein-ligand interactions"

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The Dalton Cardiovascular Research Center (DCRC) supports the objectives of the University of Missouri in its mission of teaching, research and service. Yet it is unique in its commitment to interdisciplinary collaborative research and teaching among various colleges, schools and departments across the Columbia campus. Under the auspices of DCRC, scientists from the fields of biochemistry, biological engineering, biological sciences, biomedical sciences, electrical engineering, medicine, pharmacology, physiology, physics, neurotrauma, veterinary medicine, and surgery all come together and apply their particular expertise to research problems.

Our commitment to collaboration is grounded in the belief that interactions among scientists of diverse backgrounds will lead to multidisciplinary research producing meaningful, far-reaching results. Our commitment to collaboration is grounded in the belief that interactions among scientists of diverse backgrounds will lead to multidisciplinary research producing meaningful, far-reaching results. Research programs at DCRC include investigations into cardiac functions, cystic fibrosis, exercise, kidney failure, membrane transport, muscular dystrophy, neurohumoral control of the circulation, shock, vascular wall biology, diabetes, hypertension, biomedical engineering, protein-protein interactions, and tumor angiogenesis. Because the mission of DCRC is to promote interaction and collaboration, no single group completely defines the research activity of its members.

The center is committed to excellence in cardiovascular research and in the education of students and fellows. Our investigators provide service to the University, the State of Missouri, and the nation through memberships on committees, peer review panels and editorial boards of scientific journals.

The Dalton Cardiovascular Research Center is accredited by AAALAC International and the American Association of Laboratory Animal Sciences.

R. Scott Rector, PhD, FTOS, FACS

Professor of Nutrition & Exercise Physiology and Medicine
Director, NextGen Precision Health Building
Associate Dean for Basic Sciences and Research Infrastructure,
School of Medicine
Interim Director, Dalton Cardiovascular Research Center



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Focused on Understanding the Cardiovascular System During Development, Aging, & Disease
Through Interdisciplinary Collaboration in Research and Teaching with Academic and Industry Partners

CENTER INFORMATION

CORE TECHNOLOGIES

Atomic Force microscopy
Confocal/multiphoton microscopy
Chronic instrumentation
Electrophysiology
Quantitative PCR
Cell tissue culture
Gene expression
Manipulation of protein expression
Fluorescence spectroscopy
Cardiovascular and microvascular models
High Frequency Ultrasound Imaging

CORE FACILITIES

Leica SP5 confocal multiphoton system
FV 1000 Olympus confocal systems
High Speed Spinning disk confocal
Atomic Force Microscopy Systems
Research grade florescence microscopes
Molecular and cellular technology core
Information technology core
Vevo LAZR Photoacoustic Imaging System
Telemetry
Laser Speckle Imaging
Any-Maze System
Ivis Imaging
Metabolic Cages
gentleMACS Octo Dissociator
Odyssey DLx
Real-Time PCR System
Agilent BioTek Synergy Multi-Mode Reader
Avanti JE High Speed Centrifuge

ACADEMIC PARTNERS

College of Arts and Science

Physics & Astronomy

College of Engineering

Bioengineering, Electrical &
Computer Engineering

College of Veterinary Medicine

Biomedical Sciences

School of Medicine

Biochemistry
Center for Gender Physiology
Medical Pharmacology & Physiology
Internal Medicine
Pathology and Anatomical Sciences

College of Agri., Food and Natural Resources

Food, Nutrition & Exercise Sciences

College of Health Sciences

Speech, Language & Hearing Sciences

INTERDISCIPLINARY RESEARCH INTEREST GROUPS

Biomedical Engineering
Tumor Angiogenesis
Vascular Biology
Microcirculation
Cystic Fibrosis
Membrane Transport
Exercise/Inactivity
Neurohumoral Control of Circulation
Cardiac Muscle, Development & Disease

Facilities

Erected 1967-1969

33,456 Square Feet

21 Research Labs

EXTERNAL SECTOR COLLABORATIONS

International

Univ of Calgary (CA),
 Univ of Oxford (UK)
 National Yang Ming Chiao Tung
 Southwest Medical Univ(CN)

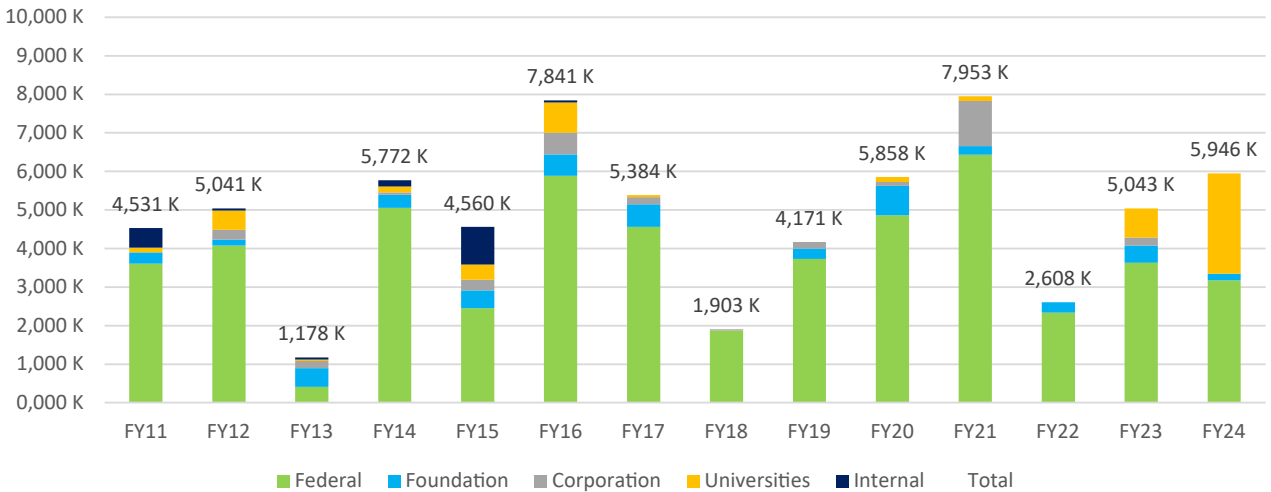
Univ of Guanajuato
 National Taiwan University
 University Taiwan

Domestic

ABBVIE Inc
 Novopyxis, Inc
 Case Western University
 State University of IOWA
 Tufts University
 University of IL Urbana, Champaign
 Pennington Biomed Research Ctr
 Washington University, St. Louis
 University of IL, Chicago
 Univ of Alabama, Birmingham
 West Virginia University
 Univ of CA, San Francisco

Soterix Medical
 Texas A&M University
 Tulane University
 UT Health San Antonio
 University of Texas Southwestern Medical Center
 Indiana University
 Albert Einstein College of Medicine
 Yale University
 Texas Tech University
 Univ of NC, Chapel Hill
 Stony Brook University (SUMY)

DCRC Research Awards Summary FY11 through FY24



Federal \$3,176,517
 Foundation \$171,000
 Universities \$2,598,789
 Total \$5,946,306

RESIDENT INVESTIGATORS



Christopher P. Baines, PhD

Associate Professor, Department of Biomedical Sciences



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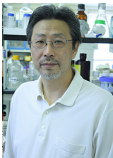
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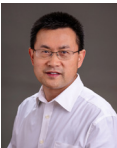
Olga Glinskii, MD
Assistant Research Professor



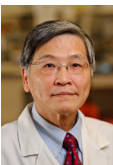
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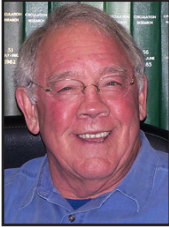
Assistant Research Professor, Dalton Cardiovascular Research Center



Xiaoqin Zou, PhD

Professor, Department of Physics and Department of Biochemistry

EMERITUS DALTON INVESTIGATORS



Edward H. Blaine, PhD, DSc(Hon), Emeritus Professor
Professor, Department of Medical Pharmacology & Physiology
Former Director, Dalton Cardiovascular Research Center 1990-2005
"Hypertension, heart failure, and salt and water balance."

Discovery of Angiotensin converting enzyme inhibitor

1962 NFL Draft, Offensive Line Green Bay Packers, retired after 5th season with the Philadelphia Eagles to come back to Mizzou for his doctorate.(5 years, a promise to mentor, Clint Conaway)
Distinguished Eagle Scout by the Boy Scouts of America, 2009
Missouri Sports Hall of Fame, 2011



Gerald A. Meininger, PhD, Emeritus Professor
Margaret Proctor Mulligan Professor in Medical Research
Professor, Department of Medical Pharmacology and Physiology
Former Director, Dalton Cardiovascular Research Center 2005-2015
Adjunct Professor, Department of Biomedical Sciences
Adjunct Professor, Department of Biological Engineering

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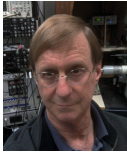
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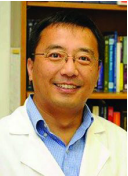
Pathology and Anatomical Sciences

Non- Resident Investigators



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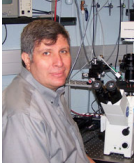
Assistant Professor, Department of Biomedical Sciences



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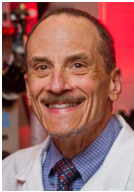
Associate Professor Nutrition & Exercise Physiology

Non-Resident Investigators



Luis Polo-Parada, PhD

Associate Professor, Department of Medical Pharmacology and Physiology



Steven S. Segal, PhD

Professor of Department of Medical Pharmacology and Physiology



James R Sowers, MD

Adjunct Professor of Clinical Medicine

Publications

1. Resmetirom, the first approved drug for the management of metabolic dysfunction-associated steatohepatitis: Trials, opportunities, and challenges. Kokkorakis M, Boutari C, **Hill MA**, Kotsis V, Loomba R, Sanyal AJ, Mantzoros CS. *Metabolism*. 2024 May;154:155835. doi: 10.1016/j.metabol.2024.155835. Epub 2024 Mar 19. PMID: 38508373
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20. Dietary NMN supplementation enhances motor and NMJ function in ALS. Lundt S, Zhang N, **Polo-Parada L**, Wang X, **Ding S**. *Exp Neurol*. 2024 Apr;374:114698. doi: 10.1016/j.expneurol.2024.114698. Epub 2024 Jan 22. PMID: 38266764
21. Endothelial cell serum and glucocorticoid regulated kinase 1 (SGK1) mediates vascular stiffening. Zhang L, **Sun Z**, Yang Y, Mack A, Rodgers M, Aroor A, **Jia G**, **Sowers JR**, **Hill MA**. *Metabolism*. 2024 May;154:155831. doi: 10.1016/j.metabol.2024.155831. Epub 2024 Feb 29. PMID: 38431129
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23. Abstinence Restores Cardiac Function in Mice with Established Alcohol-Induced Cardiomyopathy. Edavettal JM, Harris NR, Cohen SE, Paloczi J, **Chandrasekar B**, Gardner JD. *Cells*. 2023 Dec 7;12(24):2783. doi: 10.3390/cells12242783. PMID: 38132102
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Publications

26. Opinion: Protein folds vs. protein folding: Differing questions, different challenges. Chen SJ, Hassan M, Jernigan RL, Jia K, Kihara D, Kloczkowski A, Kotelnikov S, Kozakov D, Liang J, Liwo A, Matysiak S, Meller J, Micheletti C, Mitchell JC, Mondal S, Nussinov R, Okazaki KI, Padhorny D, Skolnick J, Sosnick TS, Stan G, Vakser I, **Zou X**, Rose GD. Proc Natl Acad Sci U S A. 2023 Jan 3;120(1):e2214423119. doi: 10.1073/pnas.2214423119. Epub 2022 Dec 29. PMID: 36580595
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28. Computational Modeling of IN-CTD/TAR Complex to Elucidate Additional Strategies to Inhibit HIV-1 Replication. Qiu L, Bhutoria S, Kalpana GV, **Zou X**. Methods Mol Biol. 2023;2610:75-84. doi: 10.1007/978-1-0716-2895-9_7. PMID: 36534283
29. Synthesis of a Near-Infrared Fluorescent Probe for Imaging Catecholamines via a Tandem Nucleophilic Aromatic Substitution. Zhang L, Liu XA, **Gillis KD**, Glass TE. Org Lett. 2023 Dec 29;25(51):9103-9107. doi: 10.1021/acs.orglett.3c03343. Epub 2023 Dec 18. PMID: 38108670
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31. Template-guided method for protein-ligand complex structure prediction: Application to CASP15 protein-ligand studies. Xu X, Duan R, **Zou X**. Proteins. 2023 Dec;91(12):1829-1836. doi: 10.1002/prot.26535. Epub 2023 Jun 7. PMID: 37283068
32. Discriminating physiological from non-physiological interfaces in structures of protein complexes: A community-wide study. Schweke H, Xu Q, Tauriello G, Pantolini L, Schwede T, Cazals F, Lhéritier A, Fernandez-Recio J, Rodríguez-Lumbreras LA, Schueler-Furman O, Varga JK, Jiménez-García B, Réau MF, Bonvin AMJJ, Savojardo C, Martelli PL, Casadio R, Tubiana J, Wolfson HJ, Oliva R, Barraud-Bautista D, Ricciardelli T, Cavallo L, Venclovas Č, Olechnovič K, Guerois R, Andreani J, Martin J, Wang X, Terashi G, Sarkar D, Christoffer C, Aderinwale T, Verburgt J, Kihara D, Marchand A, Correia BE, Duan R, Qiu L, Xu X, Zhang S, **Zou X**, Dey S, Dunbrack RL, Levy ED, Wodak SJ. Proteomics. 2023 Sep;23(17):e2200323. doi: 10.1002/pmic.202200323. Epub 2023 Jun 27. PMID: 37365936

Publications

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34. Purposefully Designed Surfactants for Facile and Controllable Gold Colloidal Nanocrystal Synthesis. Bhawawet N, **Polo-Parada L**, Ishtaweera P, Larm NE, Baker GA. ACS Omega. 2023 Oct 23;8(44):41633-41640. doi: 10.1021/acsomega.3c05795. eCollection 2023 Nov 7. PMID: 37969977
35. Transcriptomic analysis reveals novel molecular signaling networks involved in low voluntary running behavior after AP-1 inhibition. Mao X, Grigsby KB, Kelty TJ, Kerr NR, Childs TE, **Booth FW**. Neuroscience. 2023 Jan 15;509:173-186. doi: 10.1016/j.neuroscience.2022.11.008. Epub 2022 Nov 14. PMID: 36395916
36. Safety of TCMCB07, a melanocortin-4 antagonist peptide, in dogs with naturally occurring cachexia. Axiak-Bechtel SM, Leach SB, Newton-Northup JR, Milner RJ, Fox-Alvarez SA, Fagman LI, Young KA, Tate DJ, Wright ZM, Chretien JD, Allen JW, Yoshimoto SK, Selting KA, Flesner BK, White CR, Mills T, Aherne M, Bergman PJ, Qi L, **Gruber KA**, Callahan MF. J Vet Intern Med. 2023 Nov-Dec;37(6):2344-2355. doi: 10.1111/jvim.16915. Epub 2023 Oct 28. PMID: 37897303
37. Postnatal development of extracellular matrix and vascular function in small arteries of the rat. Nourian Z, Hong K, Li M, Castorena-Gonzalez JA, **Martinez-Lemus LA**, Clifford PS, **Meininger GA**, **Hill MA**. Front Pharmacol. 2023 Aug 15;14:1210128. doi: 10.3389/fphar.2023.1210128. eCollection 2023. PMID: 37649891
38. Dorsal motor vagal neurons can elicit bradycardia and reduce anxiety-like behavior. Strain MM, Conley NJ, Kauffman LS, Espinoza L, Fedorchak S, Martinez PC, Crook ME, Jalil M, Hodes GE, Abbott SBG, Güler AD, Campbell JN, **Boychuk CR**. iScience. 2024 Feb 6;27(3):109137. doi: 10.1016/j.isci.2024.109137. eCollection 2024 Mar 15. PMID: 38420585
39. Selective breeding for physical inactivity produces cognitive deficits via altered hippocampal mitochondrial and synaptic function. Kerr NR, Kelty TJ, Mao X, Childs TE, **Kline DD**, Rector RS, **Booth FW**. Front Aging Neurosci. 2023 Apr 3;15:1147420. doi: 10.3389/fnagi.2023.1147420. eCollection 2023. PMID: 37077501

Publications

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41. Study of erythrocyte sedimentation in human blood through the photoacoustic signals analysis. Pérez-Pacheco A, Ramírez-Chavarría RG, Colín-García MP, Cortés-Ortegón FDC, Quispe-Siccha RM, Martínez-Tovar A, Olarte-Carrillo I, **Polo-Parada L**, Gutiérrez-Juárez G. *Photoacoustics*. 2024 Mar 2;37:100599. doi: 10.1016/j.pacs.2024.100599. eCollection 2024 Jun. PMID: 38495950
42. Hepatocellular RECK as a Critical Regulator of Metabolic Dysfunction-associated Steatohepatitis Development. Dashek RJ, Cunningham RP, Taylor CL, Alessi I, Diaz C, Meers GM, Wheeler AA, Ibdah JA, Parks EJ, Yoshida T, **Chandrasekar B**, Rector RS. *Cell Mol Gastroenterol Hepatol*. 2024 May 24;18(3):101365. doi: 10.1016/j.jcmgh.2024.101365. Online ahead of print. PMID: 38797477
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Dalton Rodent Phenotyping Core

(Dalton RPC)

Overview

The Dalton Cardiovascular Research Center Rodent Phenotyping Core provides for the in vivo study of cardiovascular function, metabolism, drug distribution, and aspects of behavior/learning. The core is a resource available to researchers within the University of Missouri and collaborating institutions. The core is also suited and available to industry partnerships. Activities undertaken within the core are conducted on a 'fee-for-service' basis.

The 2200 sqft Core is AAALAC accredited and includes animal housing facilities in addition to instrumentation used in small animal phenotyping. Animal housing includes capabilities for studies to be conducted on immuno-compromised rodents and allows for the conduct of chronic studies.

Example Applications

- Assessment of animal models in pre-clinical studies
- Echocardiography in heart failure
- Pulsed wave velocity and arterial stiffness measurements
- Assessment of blood pressure by telemetry and tail cuff
- In vivo longitudinal assessment of blood flow/hemodynamics
- Assessment of hind-limb ischemia (acute and chronic)
- Assessment of microvascular perfusion and reactivity (acute)
- Tissue and tumor hypoxia
- In vivo detection of optical contrast agents (including nano-particles, dyes and indicators) in tumors or tissues
- Tumor sizing
- Behavioral studies in genetic models or post interventions (e.g. surgical induction of stroke).
- Metabolic studies
- Impact of exercise training/interventions

Benefits

The core facility provides access to instrumentation that is not routinely available in individual laboratories or is used only on an intermittent basis.

Additional benefits include:

- Documentation useful in the preparation of animal protocols and grant applications.
- The standardization of approaches and practices, enhancing quality control.
- Both the core and animal housing are in one location for convenience and to minimize stress on the animals.
- Development of cross-disciplinary collaborations.

Instrumentation and Resources

Equipment

The Small Animal Phenotyping Core houses an array of instrumentation used in the in vivo characterization of experimental animal models. While emphasis is placed on cardiovascular applications the core is of high value to many other areas including studies of metabolism, tissue hypoxia, tumor growth, and behavior. Equipment and facilities within the core includes:

- Visualsonic Vevo 2100 high frequency ultrasound system equipped with high-resolution ultrasound transducers designed for rat and mouse (9 – 70 MHz).
- Visualsonics Vevo-LAZR system for in vivo high resolution photoacoustic imaging of small animals
- Biosafety level 2 hood located next to the Vevo 2100 enabling imaging to be performed on animals that are immuno-compromised or have been exposed to biosafety level 2 agents
- Moor Instruments Laser Speckle Contrast Imager (moorFLPI-2)
- Bioluminescence/Fluorescence imaging (IVIS Lumina X5, Perkin Elmer)
- DSI Telemetry system for both mice and rats
- Metabolic cages (Promethion, Sable Instruments); mouse and rat.
- Behavior monitoring capabilities (Stoelting Any-Maze Video Tracking with open field, mazes and environment preference apparatus)
- Isoflurane anesthesia delivery systems
- Small animal survival surgery facilities including operative microscopes and light sources.
- Necropsy/tissue procurement room
- Ventilated racks and biosafety level 2 hoods in each animal room

Technical Support

- Animal housing and care is provided by fully trained and AALAS certified laboratory animal care staff.
- Veterinary care is provided by Office of Animal Resources, University of Missouri.
- Technical support is available for training and use of equipment. Ongoing technical assistance is available for some procedures (please enquire).

Data Handling, Analysis and Storage

Options are provided for off-line data analysis in most scenarios.

Options are also available for temporary storage and archiving of large image/data files.

Lunch and Learn

Commenced on June 3, 2024 as a way of introducing Investigators to each other and creating possible collaborations and are scheduled to take place the first Monday of each Month.

Dr Shaoping Hou, Associate Professor, Physical Medicine and Rehabilitation Pathology and Anatomical Sciences, School of Medicine presented, " Autonomic dysfunction after spinal cord injury: mechanisms and therapeutics."

Dr Teresa Pitts, Associate Professor, Department Chair Speech, Language, and Hearing Sciences, College of Health Sciences presented, "Down & Back again: The spinal Cord May lead the Way to Laryngeal Regulation."

Serotonin Team Science

The goals of Serotonin Team Science will be to share ideas, develop new ideas and define collaborative projects which could lead to future MPI and/or center level grants.

Charlene Emerson, PhD led the first meeting on June 24, 2024. Present were Scott Rector, Adebowale Adebisi, Shaoping Hou, David Arnold, Kevin Cummings, David Kline, Nicole Nichols, Teresa Pitts, Carie Boychuk and Amanda Carr.

Dalton Cardiovascular Research Center

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Giving to Dalton

Investigators at Dalton Cardiovascular Research Center seek understanding and information about some of the most prevalent health issues of the day - hypertension; heart disease; adult-onset (Type II) diabetes; obesity; muscular dystrophy; cystic fibrosis; and breast, uterine and prostate cancer. Teams of investigators from medicine, engineering, biomedical sciences, veterinary medicine, physiology and other disciplines work together to find answers to questions that will directly affect the understanding of disease prevention and treatment. Your contribution to Dalton supports this work.

You can now give directly to Dalton Cardiovascular Research Center and the [Franklin Lecture Endowment](#)

Dalton welcomes partnerships with the private sector.

Please contact Dr. Scott Rector: rectors@health.missouri.edu or 573-882-9482 to learn more.