UNMC

Mary and Dick Holland Regenerative Medicine

2019 Annual Report

Regenerative Medicine at UNMC

The Holland Regenerative Medicine Program was established at UNMC to bring many areas of science and medicine together to provide those in Nebraska and surrounding areas more advanced therapies and treatments that can enhance their quality of life beyond what we are currently capable of providing.

"A necessary component for the success of the Regenerative Medicine Program is clinical translation. It's a delicate balance that requires a multidisciplinary approach" states Nora Sarvetnick, Ph.D., Professor in the Transplant division of the UNMC Department of Surgery and Director of the Regenerative Medicine Program. Our goal is to foster collaborations between scientists and clinicians to drive new, innovative techniques that are currently absent in the field.

Dr. Sarvetnick has been working with the Regenerative Medicine Advisory Committee and Faculty to establish directions for the Regenerative Medicine Program, as well as to recruit potential candidates to fill available faculty positions. "We hope to grow the field of Regenerative Medicine at UNMC, but also give both junior and senior investigators the chance to participate in research and therapy development."

The Regenerative Medicine Program seeks to establish approaches that generate new therapies for disease. The types of activities undertaken utilize:

- Cellular Therapies, involving both adult and embryonic stem cells
- Translational Research leading to clinical trials
- Restoration with synthetic and cellular components
- Collaboration with Bioengineering Facility at UNL
- Stem Cell Differentiation
- Biotech collaborations
- Induced Pluripotent Stem Cells

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Letter from the Director

Dear Friends,

It is a great honor to continue to serve as director of the Holland Regenerative Medicine Program at the University of Nebraska Medical Center. I am excited to share some of the program's successes and our vision for the coming year. The past year has seen some interesting challenges and also some great successes. The Holland Regenerative Medicine Program continues to become locally significant, but also global in scope and impact. Among our most distinctive and important characteristics is our collaborative spirit. With numerous program activities including weekly seminars, research update talks, invited experts, annual retreats, and symposia, we foster a sense of community and provide a foundation for our shared research interests. This last year has seen some fantastic visiting and local speakers who continue to inspire further collaborative efforts and research directions.

Our mission has always been focused on bringing together forward thinking scientists and clinicians who are committed to engaging in research that brings regenerative medicine therapies from the bench to the bedside. We look forward to further evolving and adding new faculty, initiatives, and collaborations in the coming year with the introduction of new faculty who focus on exciting up-and-coming research in tissue engineering and regenerative medicine.

The past year has seen great advances in collaborations across the University system and beyond. For example, our investigators have made significant progress in the areas of wound healing, rotator cuff and bone regeneration. We connected with experts in the field of cochlear engineering during our fall conference and expanded our professional network. We connected with military research experts who have provided us valuable insights into current unmet military needs. We also connected with leaders of other renowned regenerative medicine programs and found ourselves on par with the research across the nation.

We are pleased to announce, together with Medical Sciences Interdepartmental Area (MSIA), we welcomed our first student into the Regenerative Medicine and Biomaterials Design Ph.D. program. Students enrolled in our program can expect to engage in and learn processes and methodologies affiliated with regenerative medicine and bioengineering. Relevant research includes organogenesis, tissue engineering, polymer chemistry, biomechanics, medical robotics, imaging, stem cell research and clinical therapeutics. Our program is uniquely broad, yet intimate. We have the infrastructure to maintain a close-knit and supportive learning environment and plan to make this a larger part of our mission.

Support continues to be a valuable tool of which we are profoundly thankful. We look forward to continuing to share our research with you and the scientific and educational communities.

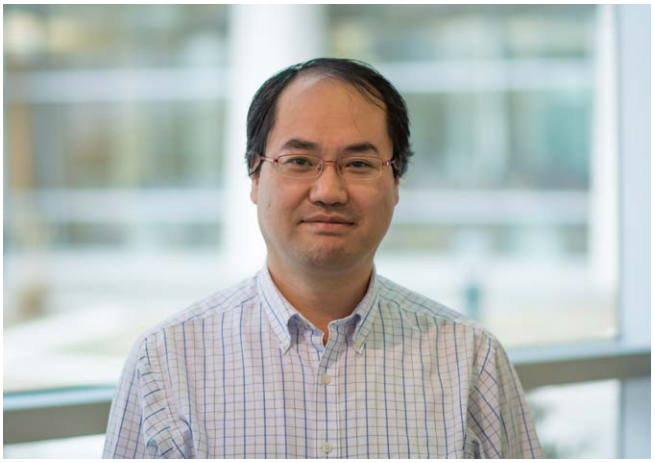
Regards

Nora Sarvetnick, Ph.D.

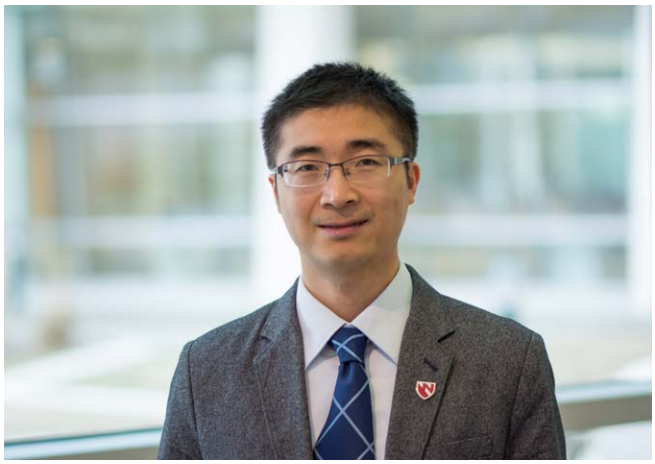
Nora Sarvetnick, Ph.D.,
Director, Holland Regenerative Medicine Program

Key Faculty

Nora Sarvetnick, Ph.D., *Professor*



Sung-Ho Huh, Ph.D., *Assistant Professor*



Bin Duan, Ph.D., *Assistant Professor*

Hyung Joon Kim, Ph.D., *Assistant Professor*

Andrew Dudley, Ph.D., *Associate Professor*

Jingwei Xie, Ph.D., *Associate Professor*

Xiaowei Li, Ph.D., *Assistant Professor*

Siwei Zhao, Ph.D., *Assistant Professor*

Administration

Brenda Blair, *Program Associate*

Tara Szymanski-Bird, *Program Associate*

Regenerative Medicine Faculty

University of Nebraska Medical Center

Ahmad, Iqbal Ph.D., *Professor, Ophthalmology & Visual Sciences*

Band, Hamid M.D., Ph.D., *Professor, Eppley Institute*

Band, Vimla Ph.D., *Professor, Genetics, Cell Biology & Anatomy*

Batra, Surinder Ph.D., *Professor, Biochemistry & Molecular Biology*

Baxter, B. Timothy M.D., *Professor, Surgery*

Black, Jennifer Ph.D., *Professor, Eppley Institute*

Buckley, Shannon Ph.D., *Assistant Professor, Genetics, Cell Biology & Anatomy*

Carlson, Mark M.D., *Professor, Surgery*

Fox, Howard M.D., Ph.D., *Professor, Pharmacology & Experimental Neuroscience*

Haider, Hani Ph.D., *Professor, Orthopaedic Surgery*

Hammel, James M.D., *Associate Professor, Surgery*

Kamenskiy, Alexey Ph.D., *Associate Professor, Surgery*

Lowes, Brian M.D., Ph.D., *Professor, Internal Medicine, Cardiology*

MacTaggart, Jason M.D., F.A.C.S., *Associate Professor, Surgery*

Mercer, David M.D., Ph.D., *Professor, Surgery*

Nawshad, Ali Ph.D., *Associate Professor, Dentistry*

Payne, Jeffrey D.D.S., *Professor, Dentistry*

Pipinos, Iraklis M.D. Ph.D., *Professor, Surgery*

Quiros, Ruben M.D., *Professor, Pediatrics Gastroenterology*

Rizzino, Angie Ph.D., *Professor, Eppley Institute*

Sharp, Graham Ph.D., *Professor, Genetics, Cell Biology & Anatomy*

Singh, Rakesh Ph.D., *Professor, Pathology and Microbiology*

Wang, Dong Ph.D., *Professor, Pharmaceutical Sciences*

Xiong, Wanfen Ph.D., *Associate Professor, Surgery*

Zheng, Jialin M.D. Ph.D., *Professor, Pharmacology & Experimental Neuroscience*

University of Nebraska – Lincoln

Dzenis, Yuris Ph.D., *R. Vernon McBroom, Mechanical & Materials, Professor, Engineering*

Farritor, Shane Ph.D., *Professor, Mechanical & Materials Engineering*

Gu, Linxia Ph.D., *Associate Professor, Mechanical & Materials Engineering*

Iverson, Nicole Ph.D., *Assistant Professor, Biological Systems Engineering*

Keshwani, Jennifer Ph.D., *Associate Professor, Biological Systems Engineering*

Kidambi, Srivatsan Ph.D., *Associate Professor, Chemical & Biomolecular Engineering*

Kievit, Forrest Ph.D., *Assistant Professor, Biological Systems Engineering*

Lei, Yuguo Ph.D., *Assistant Professor, Chemical & Biomolecular Engineering*

Lim, Jung Yul Ph.D., *Associate Professor, Mechanical & Materials Engineering*

Nelson, Carl Ph.D., *Professor, Mechanical & Materials Engineering*

Pannier, Angela Ph.D., *Associate Professor, Biological Systems Engineering*

Pedrigi, Ryan Ph.D., *Assistant Professor, Mechanical & Materials Engineering*

Riley, Mark Ph.D., *Associate Dean, College of Engineering*

Sealy, Michael Ph.D., *Assistant Professor, Mechanical & Materials Engineering*

Tamayol, Ali Ph.D., *Assistant Professor, Mechanical & Materials Engineering*

Terry, Benjamin Ph.D., *Assistant Professor, Mechanical & Materials Engineering*

Velander, William Ph.D., *Distinguished Scholar Chemical & Biomolecular Engineering*

Wachs, Rebecca Ph.D., *Assistant Professor, Biological Systems Engineering*

Yang, Ruiguo Ph.D., *Assistant Professor, Mechanical & Materials Engineering*

University of Nebraska at Omaha

Myers, Sara Ph.D., *Associate Professor, Biomechanics*

Sollars, Suzanne Ph.D., *Associate Professor, Department of Psychology*

Stergiou, Nicholas Ph.D., *Professor, Biomechanics*

Takahashi, Kota Ph.D., *Assistant Professor, Biomechanics*

Zuniga, Jorge Ph.D., *Assistant Professor, Biomechanics*

Mission, Vision and Focus

Mission

Driven by the needs of patients who seek treatment for their incurable diseases, The University of Nebraska Medical Center has established the Regenerative Medicine Program with generous support from the Holland family. Our mission, which remains unchanged from our program inception, is focused on bringing together forward thinking scientists and clinicians who are committed to understanding the basic science behind tissue engineering and development. By translating these concepts we seek to pioneer regenerative therapies that can be taken into the clinic, spreading hope throughout the Nebraskan community and around the world.

Vision

Envision a world with no donor organ shortage, where patients with diabetes are cured, damaged hearts are repaired, and gastrointestinal birth defects are corrected. Regenerative medicine may make these dreams a reality. The potential outcomes of such research and development are endless.

It is our vision that therapies for various diseases that are being developed today will offer a faster, more complete recovery with significantly fewer side effects or risk of complications.

Focus

Our program brings together several different disciplines of science including bioengineering, biology, chemistry, computer science, genetics, medicine, robotics, and many other fields. We are focused on uniting these areas as one force to battle diseases head on. We look forward to the positive outcomes our efforts will create both for patients and UNMC as a center of scientific and clinical excellence.

Looking Ahead: Goals 2019-2020

- Hire faculty in the translational biology area
- Recruit outstanding students to the new Regenerative Medicine and Biomaterials Design Ph.D. program
- Attain funding for future growth, enabling us to move in new directions
- Continue to develop new collaborative projects
- Increase contacts within industry

A successful program is one that maintains an equilibrium among its scientific strengths. Our program boasts of housing the newest techniques, technologies and expertise in bioengineering and regenerative medicine. We seek to recruit outstanding biologists in the field of translational medicine in order to maximize collaborations amongst our researchers and UNMC. We are interested in expanding extracellular matrix (ECM) research. ECM is essentially a collection of molecules that are secreted by the cells. ECM provides structural support to the surrounding cells and can play a critical role in regrowth and healing of tissue. ECM helps in stem cell growth and differentiation. Hence, understanding the regulation of ECM as well as its dynamic relationship with cells is vital for successful tissue engineering strategies. We are also interested in pursuing research in the fields of peripheral nerve regeneration and muscle regeneration.

The Regenerative Medicine and Biomaterials Design Ph.D. program will continute to admit students this year.

We look to arm our future students with knowledge that will make them impactful researchers in the field. We are excited to help mold this next generation of scientists.

We will continue to solicit input from our panel of experts in the field of Regenerative Medicine who serve on our External Advisory Board. Site visits are crucial for these members to evaluate our program and to provide future direction for growth and research opportunities. This input will be critical as we look to develop our strategic plan for the future.

After a successful conference in September 2018, we look forward to our 3rd annual conference in 2019 with a focus on adipose and mesenchymal stem cells differentiation and utility for tissue regeneration. We are inviting experts in these fields and we look forward to another year of forming new collaborations and expanding our research network.

Successes 2018-2019
New Faculty

Xiaowei Li, Ph.D.
Assistant Professor, Department of Neurological Sciences
Holland Regenerative Medicine Program
University of Nebraska Medical Center

Xiaowei Li, Ph.D., *Assistant Professor, Department of Neurological Sciences*

Dr. Li is an Assistant Professor in the Department of Neurological Sciences and the Holland Regenerative Medicine Program at the University of Nebraska Medical Center. He completed his postdoctoral training at the Johns Hopkins School of Medicine after his Ph.D. in Bioengineering at the Clemson University.

The Li laboratory focuses on exploiting bioengineering strategies for tissue regeneration by combining the principles of biomaterial science, biological science, stem cell biology, tissue engineering, regenerative medicine with the advanced techniques in molecular and cell biology. Specifically, they aim to develop biomaterial approaches to induce a permissive microenvironment to improve efficiency of stem cell-based therapies for tissue regeneration after traumatic brain/spinal cord injury or ischemic stroke. They have developed a structurally hyaluronic acid hydrogel that generated robust neovascular networks at the lesion site after traumatic brain injury or ischemic stroke. The optimized hydrogel greatly improved the survival of co-delivered human neural stem cells. Additionally, they also apply biomaterial platforms to influence endogenous cell fates to promote functional tissue regeneration.

Siwei Zhao, Ph.D.
Assistant Professor, Department of Surgery – Transplant
Holland Regenerative Medicine Program
University of Nebraska Medical Center

Siwei Zhao, Ph.D., *Assistant Professor, Department of Surgery – Transplant*

Dr. Zhao is an Assistant Professor in the Department of Surgery – Transplant. Dr. Zhao received multidisciplinary academic trainings, including a B.S. in electrical engineering and microfabrication, a Ph.D. in biomedical engineering, and postdoc training in the fields of biomaterial and tissue engineering.

The Zhao lab focuses on the development of novel electrical systems that allow seamless interface with biological tissues. Although current biologically interfacing devices have evolved over many generations and achieved unprecedented performance, they suffer from fundamental mismatches with living biological systems. These mismatches primarily lie in the material properties and system designs, including the mechanical properties, chemical composition, adaptability to environmental changes, and signal transmission and processing. These mismatches prevent current systems from forming seamless interfaces and integration with biological systems, which has caused inconsistent outcomes and even damages to tissues. His short-term goal is to develop novel electrical materials and circuit designs to allow safe delivery of high-strength therapeutic electrical stimulation to human body and improve the outcome of electrical stimulation-assisted treatment.

Successes 2018-2019
Research Highlights

UNMC Researchers Aim to Improve Hernia Mesh

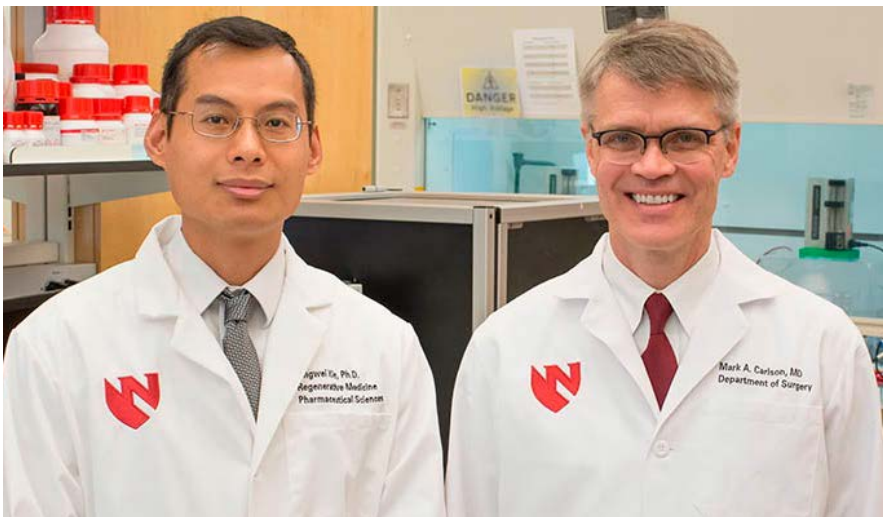
by Kalani Simpson, UNMC public relations | May 07, 2018

UNMC faculty Mark Carlson, M.D., and Jingwei Xie, Ph.D., are working together on a solution for a better hernia mesh. And they think they may have found it. Holes in the abdomen can't always be effectively sewn together, so they require a patch or "mesh."

Maybe someday regenerative medicine will (literally) fill that hole. "But we're not there yet," Dr. Carlson said. Instead, physicians now mainly use synthetic materials -- plastics, which are, "Not perfect," Dr. Carlson said. The body can have adverse reactions to foreign material. Or, "biologic mesh," derived from derived from tissue such as skin, which is much more body-friendly. But, "I wince every time I use it," Dr. Carlson said. Biologic mesh is so prohibitively expensive it requires level upon level of scrutiny by hospitals and insurance companies. We need something the human body will approve of, at a price the health care system will, too.

Dr. Xie, a biomedical engineer in the Department of Surgery and Holland Regenerative Medicine Program at UNMC, and Dr. Carlson, a surgeon-scientist, who has a dual appointment at UNMC and the VA Nebraska Western-Iowa Health Care System, are developing a mesh engineered from man-made materials - synthetic polymers. But, which they believe will be much friendlier to living tissue.

"The secret sauce is how you put (the particles) together," Dr. Carlson said. "Dr. Xie is able to control things at the nano scale." This means chemistry at the molecular level, to give the mesh "in vivo," or living, characteristics. Its highly porous structure allows optimal cell and tissue growth. "The surface composition and nanotopography reduce the adhesion formation," Dr. Xie said. Native tissue would incorporate it and form firm attachments. "The tissue actually grows into it -- and that reduces the risk of infection and strengthens the native tissue," Dr. Carlson said. The body would eventually absorb the material. The idea, and its initial preclinical data, have resulted in a grant from the Otis Glebe Medical Research Foundation. The team will test the mesh in porcine models in hopes of heading toward FDA testing and approval.



Jingwei Xie, Ph.D., left, and Mark Carlson, M.D., may have found a solution for a better hernia mesh.

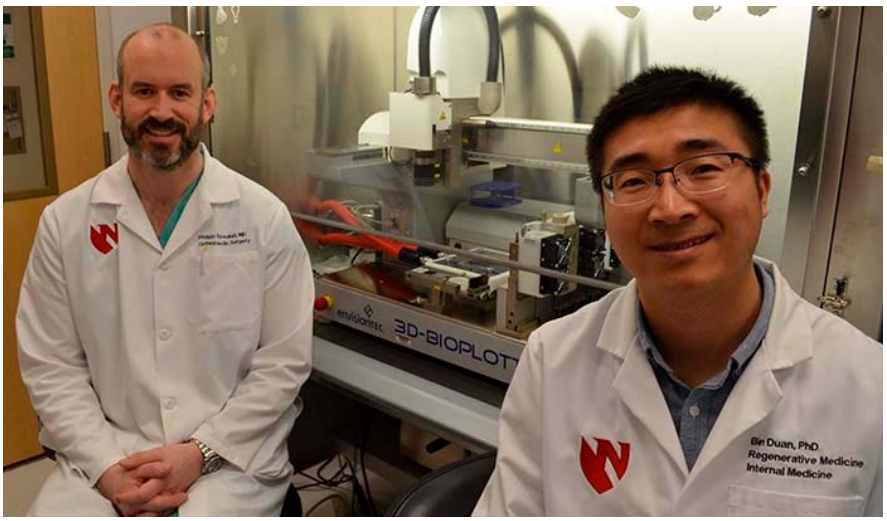
Drs. Carlson and Xie are working with UNeMed, UNMC's technology transfer arm, and are applying for a provisional patent of the technology. With further preclinical data, the team could partner with a private company, to keep the research moving, or apply for a small business grant. Through it all, "The Omaha VA has been enormously supportive of our lab," Dr. Carlson said.

UNMC lands grant to evaluate new way to repair rotator cuff injuries

by Vicky Cerino, UNMC | March 20, 2019

The National Institutes of Health has awarded UNMC a five-year, $1.9 million grant to study severe tears of the rotator cuff, a common problem that impacts thousands of people every year. The rotator cuff is a set of four muscles and tendons that play a key role in function of the shoulder. When injuries of the rotator cuff aren't treated adequately, they may significantly affect quality of life. The result can be ongoing shoulder pain, inability to raise the arm, and, eventually shoulder arthritis. "Rotator cuff pathology is one of the main clinical problems we treat in shoulder surgery," said Philipp Streubel, M.D., associate professor of orthopedic surgery at UNMC and an orthopedic surgeon who specializes in shoulder surgery at Nebraska Medicine. "We're trying to find a better way to fix them, especially in younger people with large tears where we don't have enough tissue to repair them."

"Small tears can be fixed and they heal uneventfully in the vast majority of cases. However, when you have a large irreparable tear, healing responses can drop down to single digit percentages." Dr. Streubel and UNMC biomedical engineer Bin Duan, Ph.D., assistant professor in the division of cardiovascular medicine and the Mary & Dick Holland Regenerative Medicine Program, are the principal investigators of the NIH grant. Dr. Duan said the team's goal is to engineer a rotator cuff graft, using a special 3D printer and bio ink to mimic the native structure of the rotator cuff. In his lab, he is creating tissue specific cell structures on woven nanofiber textiles with the help of a 3D printer. The structure will then be tested in rotator cuff tears in laboratory animal models.



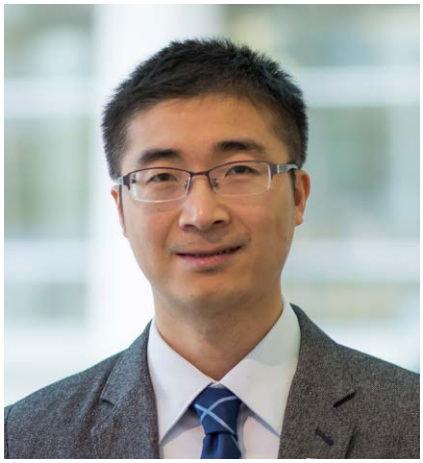
Collaborators Phillip Streubel, M.D., left, and Bin Duan, Ph.D., right.

Currently, there are multiple tissue options available to graft large irreparable tears, but the results are mixed. In their study, Drs. Duan and Streubel will use cutting-edge technology to create scaffolds they hope will ultimately repopulate with the patient's own cells, while closely mimicking the complex microstructure of muscle, tendon and bone. "Despite the current advances in tissue augmentation, the reported overall failure rate is between 15 and 40 percent," Dr. Streubel said. "One of the current problems is we're trying to fill up a complex type of tissue with a more simple structural graft."

"Irreparable rotator cuff tears are missing tissue that transitions through multiple types of properties from muscle into tendon and finally into bone. Current graft options only provide a single type of tissue which has proven to be suboptimal," he said. More than 250,000 rotator cuff repair surgeries are performed annually in the U.S. alone. Preliminary studies have shown the bioengineered grafts to be safe and viable. They are now testing if the graft is effective in repairing rotator cuff tears. "I think it's important to have the connection between the researcher and clinician to target a clinical problem," Dr. Duan said. "We can only find these innovative solutions by collaborating across specialties and scientific fields."

The research builds on the work Dr. Duan has done over the past several years. Dr. Streubel said the availability of nano yarns (yarns of calibers within the nanometer range) has allowed Dr. Duan to create very unique woven textiles that provide the backbone onto which tissue specific cells and growth factors can be printed on. Hydrogels containing these cells and growth factors are used as biologic inks that are then printed into three-dimensional structures.

Successes 2018-2019
Research Highlights



Bin Duan, Ph.D., *Assistant Professor, Department of Internal Medicine - Cardiology*

New Investigator Awards

Dr. Bin Duan was recently recognized as a new investigator by UNMC. New investigator awards go to outstanding UNMC scientists who in the past two years have secured their first funding from the National Institutes of Health, the Department of Defense or other national sources. New investigators also have to demonstrate scholarly activity such as publishing their research and/or presenting their findings at national conventions.

National Coalition of Lifesaving Cures — Dr. Harold M. and Bevery Maurer Scientific Achievement Award

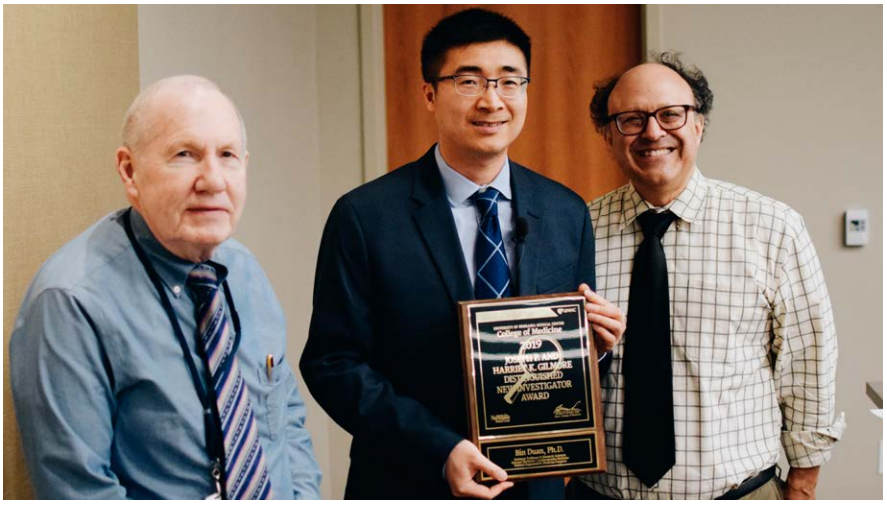
In 2014, the Nebraska Coalition for Lifesaving Cures founded the Chancellor Emeritus Harold M. Maurer, M.D., and Beverly Maurer Scientific Acheivement award. The award recognizes the accomplishments of University of Nebraska scientists or clinicians who demonstrate promise in research topics that improve lives of Nebraskans and people around the world. Dr. Xie was presented his award on April 29, 2019.

Jingwei Xie, Ph.D., *Associate Professor, Department of Surgery - Transplant*

Jingwei Xie, Ph.D. with James Turpen, Ph.D. on right.

Gilmore Award

Dr. Bin Duan was the 2019 recipient of the The Joseph P. and Harriet K. Gilmore Distinguished New Investigator Award. This award was originally named for Joseph Gilmore, Ph.D., who served as professor and chairman of the UNMC Department of Physiology and Biophysics from 1970 to 1987. Dr. Gilmore died in 2007 at age 78. In 2016, the award was re-named to also honor Dr. Gilmore's wife, Harriet. Joe and Harriet were lifelong companions who grew up together in Brooklyn, N.Y. Dr. Gilmore elevated the level of cardiovascular and renal research at UNMC to world-class levels and obtained the first NIH training grant at UNMC. This award recognizes outstanding research contributions by young UNMC faculty members.



From left to right, Gerald Moore, M.D., Bin Duan, Ph.D., Howard Fox, M.D., Ph.D.

University-wide Departmental Teaching Award (UDTA)

Andrew Dudley, Ph.D., Associate Professor, Department of Genetics, Cell Biology and Anatomy and the Holland Regenerative Medicine Program was recognized on April 24, 2018 as a departmental recipient of the UDTA award. The UDTA, one of the President's Faculty Excellence Awards, is NU's most prestigious honor for departmental excellence in teaching. Since 1993, the UDTA has recognized departments or units within the university that have made unique and significant contributions to NU's teaching efforts and that have demonstrated outstanding commitment to the education of students at the undergraduate, graduate or professional levels. Honored departments, selected by a committee of faculty members from across the university, receive $25,000 to be used in a manner the department sees fit, such as for travel to a conference, instructional equipment or improvements to a classroom or student resources. GCBA is the only department that has the honor of receiving this university-wide award twice since the award's inception.

Andrew Dudley, Ph.D., pictured second from right.

Successes 2018-2019
Research Highlights

Second Annual Regenerative Medicine Conference

The Inner Ear Biology and Regenerative Research Conference was held September 18, 2018. The conference was hosted by Dr. Sung-Ho Huh, Department of Neurological Sciences and the Holland Regenerative Medicine Program. Experts in the area of inner ear biology were invited from all over the country. Also in attendance were bioengineers from UNL, researchers from UNO, physicians and other scientists from UNMC. It was a successful event that resulted in several new collaborations.

Featured speakers:

Andy Groves, Ph.D.
Professor and Vivian L. Smith Endowed Chair in Neuroscience, Department of Neuroscience, Baylor College of Medicine

Title: The Barriers to Hair Cell Regeneration

Thomas Coate, Ph.D.
Assistant Professor and Director, Neurobiology Major, Georgetown University

Title: Control of Cochlear Innervation by Pou3f4

Jian Zuo, Ph.D.
Professor and Chair, Department of Biomedical Sciences, School of Medicine, Creighton University

Title: Cochlear Hair Cell Regeneration

David Zhi-Zhou He, M.D., Ph.D.
Professor, Department of Biomedical Sciences, School of Medicine, Creighton University

Title: Regeneration of Stereo Cilia Bundles of Cochlea Hair Cells

Sung-Ho Huh, Ph.D.
Assistant Professor, Department of Neurological Sciences, member of Holland Regenerative Medicine, UNMC

Title: Role of b-catenin During Sensory Progenitor Differentiation

A.J. Mellott, Ph.D.
Research Assistant Professor, Plastic Surgery, University of Kansas Medical Center

Title: Exploiting Human Wharton's Jelly Cells for Inner Ear Tissue Engineering

Karl Koehler, Ph.D.
Assistant Professor, Otolaryngology-Head & Neck Surgery, Indiana University School of Medicine

Title: Building Inner Ear Organoids from Stem Cells

Dominic Cosgrove, Ph.D.
Senior Scientist and Director, Center for Sensory Neuroscience, Boys Town National Research Hospital

Title: Mechanism of Otopathology in Alport Syndrome

Successes 2018-2019
Development Highlights

New Grants

Sung-Ho Huh, Ph.D.

Assistant Professor
Department of Neurological Sciences
Mary and Dick Holland Regenerative Medicine Program

NE LB606
"Mechanism Regulating Sensory Stem Cell Generation"

This objective of this project is to study the mechanisms regulating postnasal auditory sensory progenitor generation.

UAB The Hepato/Renal Fibrocystic Disease Core Pilot Grant
"Role of Etv4 and Etv5 for the Kidney Cyst Formation"

The objective of this project is to delve deeper into the understanding of the role of Etv4 and Etv5 in cytogenesis during renal development.

The University of Nebraska Collaboration Initiative/System Science Seed Grant
"Growth Factor Dynamics and Regenerative Capacity of Gustatory and Somatosensory Systems Using Microfluidics"

The objective of this study is to develop a microfluidic device enabling somatosensory neuron culture and understand roles of growth factors in the somatosensory regeneration and regeneration. Drs. Huh, Sollars and Kim aim to understand regenerative capacity in multiple sensory systems. We will identify molecular and cellular factors that result in the ability to change regenerative capacity, specifically to promote regeneration in the neonatal gustatory system, which fails to regenerate after neural injury.

Core Facility User Grant

The objective of this study is for single cell RNA sequencing and analysis of cochlear cells to understand the role of Wnt/b-catenin during cochlear development.

Jingwei Xie, Ph.D.

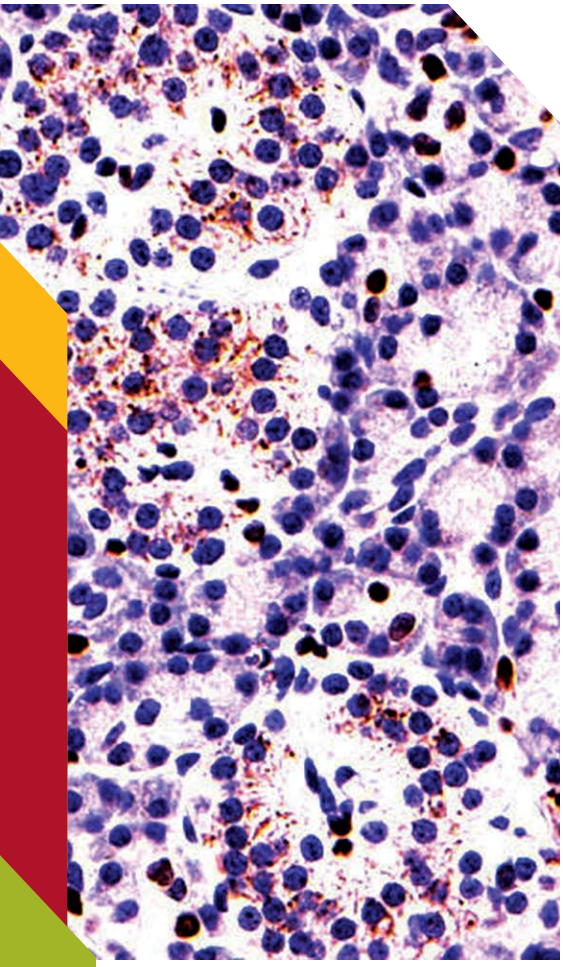
Associate Professor
Department of Surgery – Transplant
Mary and Dick Holland Regenerative Medicine Program

NIH/NIDCR R21
"Small Molecules Bound 3D Hybrid Nanofiber Aeorgels for Healing Large Cranial Bone Defects"

The objectives of this study are to: i) Establish effective coupling of modified BMP2 peptides with 3D hybrid nanofiber aerogels and examine their cell response in vitro; and ii) Determine the bone regenerative capacity of BMP2 peptide incorporated 3D aerogels using a critical-sized rat calvarial bone defect model.

NE LB606
"ADSCs-Seeded 3D Aerogels for Cranial Bone Regeneration"

The primary objective is to develop and validate absorbable 3D hybrid nanofiber aerogels that delivers adipose derived stem cells (ADSCs) for enhancing osteogenesis, neovascularization, and bone regeneration.



Hyung Joon Kim, Ph.D.

Assistant Professor, Department of Psychiatry
Mary and Dick Holland Regenerative Medicine Program

University of Nebraska Collaboration Initiative/System Science Seed Grant
Title: "Growth Factor Dynamics and Regenerative Capacity of Gustatory and Somatosensory Systems Using Microfluidics"

The objective of this study is to develop a microfluidic device enabling somatosensory neuron culture and understand roles of growth factors in the somatosensory regeneration and regeneration. Drs. Huh, Sollars and Kim aim to understand regenerative capacity in multiple sensory systems. We will identify molecular and cellular factors that result in the ability to change regenerative capacity, specifically to promote regeneration in the neonatal gustatory system, which fails to regenerate after neural injury.

Mary & Dick Holland Regenerative Medicine Program Pilot Grant

Title: "Microphysiological System for Modeling the Hippocampal Integrity"

The goal of this project is to reconstruct a regional circuit in the hippocampus using human induced pluripotent stem cells.

Xiaowei Li, Ph.D.

Assistant Professor, Department of Neurological Sciences
Mary and Dick Holland Regenerative Medicine Program

AHA Career Development Award

Title: "Promoting Organization and Integration of Transplanted Stem Cells for Brain Tissue Regeneration after Stroke"

The objective of this study is to organize transplanted stem cells following ischemic stroke. Specific Aim 1: To develop a nanofiber-hydrogel composite with uniaxial alignment cue, and demonstrate its ability to organize hiPSC-derived NSCs during differentiation. Specific Aim 2: To examine the survival, organization, differentiation, maturation, and integration of transplanted hiPSC-derived NSCs, and demonstrate advantages of nanofiber-hydrogel composite in promoting structural repair and functional recovery of stroke-injured brain.

Din Buan, Ph.D.

Assistant Professor, Department of Internal Medicine – Cardiology
Mary and Dick Holland Regenerative Medicine Program

NIH R21

Title: "Modeling Chikungunya Virus Infection in a Vascularized Bone Model"

The goal of this project is to explore and elucidate the mechanisms underlying the bone pathology observed during CHIKV infection. This project seeks to explore and elucidate the mechanisms underlying the bone pathology observed during chikungunya virus (CHIKV) infection. They will test the permissivity of osteoblast, osteoclast and endothelial cells to infection in a 2D co-culture model. Further, they will test CHIKV infection in tri-culture model. They will develop a chronic CHIKV infected vascularized bone model. Further, they will isolate and analyze exosomal proteins in order to identify potential therapeutic targets

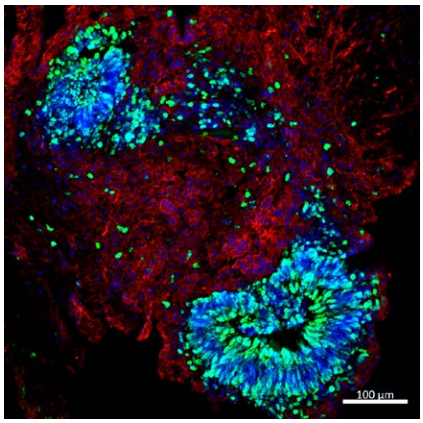
NIH R01

Title: "3D Bioprinting of Biomimetic Constructs for Rotator Cuff Augmentation"

The goal of this project is to combine biotextile and 3D bioprinting techniques to generate rotator cuff constructs with zonal cellular phenotypes and vascular patterns to promote infraspinatus rotator cuff healing in the rabbit model. This proposal will combine 3D bioprinting technique and biotextile technique to develop living, engineered rotator cuff grafts with zonal cellular and vascularization structure to mimic the native tissue and promote tendon-to-bone healing. The results of this project will seek to better understand the roles of exogenous stem cells and vasculature on rotator cuff healing in vitro and in vivo in the rabbit model and have the implications for possible therapeutic application for other soft-to-hard tissue interface regeneration.

LB506

Title: "Validate 3D Bioprinted Hydrogels to Discover Hypoxia Pathway Inhibitors"



The goal of this project is to utilize a 3D bioprinted breast cancer cell model that has been developed and used to establish the role of hypoxia-inducible factor 1-alpha (HIF1α)-mediated hypoxia response that culminates in epithelial mesenchymal transition, to screen a kinase inhibitor library that includes members previously shown to inhibit the HIF-1 pathway. The goal of this proposal is to utilize 3D bioprinted breast cancer cell model that they have developed and used to establish the role of hypoxia-inducible factor 1-alpha (HIF1α)-mediated hypoxia response that culminates in epithelial mesenchymal transition (EMT), to screen a kinase inhibitor library that includes members previously shown to inhibit the HIF-1 pathway.

Featured Speakers

Matthew MacEwan, Ph.D.

Matthew MacEwan, Ph.D., is the founder, president and chief scientific officer of Retectix, LLC, located in St. Louis. Retectix is a medical device company focused on the development and production of nanofabricated surgical meshes and biomaterials using novel platform technology developed at Washington University in St. Louis. In his leadership role at Retectix, MacEwan is responsible for product development, pre-clinical/clinical testing, regulatory compliance and corporate strategy. MacEwan is a member of the Medical Scientist Training Program at Washington University in St. Louis and is pursuing a Ph.D. in biomedical engineering and an M.D. with clinical specialization in neurosurgery. Before attending Washington University in St. Louis, MacEwan graduated summa cum laude with a bachelor's degree in biomedical engineering from Case Western Reserve University in Cleveland, Ohio, with a specialization in polymer biomaterials/biomaterial biocompatibility. We were honored to host Dr. MacEwan in December 2018 for our Surgery Research Forum.

Yadong Wang, Ph.D.

Yadong Wang obtained his Ph.D. degree at Stanford University in 1999, performed his postdoctoral studies at MIT, and joined the Georgia Institute of Technology in 2003 as an assistant professor. He was recruited to Pittsburgh in 2008. He has published high-impact articles at every stage of his academic career in journals including Science, Nature Biotechnology, Nature Medicine, and PNAS. Several of his inventions are licensed, one polymer he invented is now commercially available and approved for clinical use. He co-founded two companies to translate the technologies developed in his laboratory. His research focuses on creating biomaterials that will solve key challenges in the cardiovascular, nervous and musculoskeletal systems. His team enjoys collaboration with others who share the same passion for translational research. We were honored to host Dr. Wang in April 2019 for our Surgery Research Forum special seminar series.

Younan Xia, Ph.D.

Dr. Xia serves as Brock Family Chair and Georgia Research Alliance Eminent Scholar in Nanomedicine, The Wallace H. Coulter Department of Biomedical Engineering, Georgia institute of Technology and Emory University. His research interest includes electrospun nanofibers and widespread use in biomedical research and other areas. Owing to the small fiber diameter, high porosity, and specific large surface area, a nonwoven mat of electrospun nanofibers offers an ideal scaffolding material to mimic the extra cellular matrix (ECM) for cell attachment and nutrient transportation. The nanofibers can also be readily functionalized through encapsulation or attachment of bioactive species such as ECM proteins, enzymes, and growth factors. In addition, the nanofibers can be further assembled into a variety of arrays or hierarchical structures by manipulating their alignment, stacking, and/or folding. All these attributes make electrospun nanofibers well-suited for a broad range of biomedical applications that include controlled release, drug delivery, wound dressing, tissue engineering, and regenerative medicine. We were honored to host Dr. Xia in April 2019 for our special research series.

Arup Indra, Ph.D.

Arup K. Indra is currently a co-Director of the Oregon Health & Science University (OHSU) – Oregon State University (OSU) Cancer Prevention & Control Initiative and interim-director of the Pharmaceutical Sciences graduate program in the OHSU/OSU College of Pharmacy.

Arup Indra is an Associate Professor of Pharmaceutical Sciences in the College of Pharmacy at OSU and an Adjunct Associate Professor in the Department of Dermatology at OHSU. He is also a member of the Knight Cancer Institute at OHSU and an affiliated Principal Investigator at Linus Pauling Institute at OSU.

He earned his Master's degree from Kolkata University, a Ph.D. degree in Molecular Biology at Jadavpur University, India and did a Post-Doctoral training with molecular biologist and Albert Lasker Award Winner Professor Pierre Chambon at Institute of Genetics, Cell and Molecular Biology (IGBMC) in Strasbourg, France. He was later a Research Scientist in Pierre's group working on collaborative projects with Deltagen Inc., came to OSU in 2005 in a tenure track position and to OHSU in 2010.

Dr. Indra is nationally and internationally recognized for his work on skin development, inflammatory skin disease, wound healing and melanoma. Dr. Indra's laboratory is investigating the mechanisms of skin development and healing from stem cells and his group has identified key factors essential for establishment of a protective epidermal barrier, lack of which can trigger inflammatory skin diseases e.g. atopic dermatitis (AD). His team is also studying the cell-cell signaling that is functional in the "tumor microenvironment" and contributing to melanoma metastasis.

Dr. Indra serves on different national and international grant review panels. As a devoted mentor, he inspires and challenges his trainees to gain knowledge and fosters their critical thinking for future success and academic excellence. We were honored to host Dr. Indra in April 2019 for our special research series.

Hongli Sun, Ph.D.

Dr. Sun's research seeks to develop novel biomaterials-based strategies to improve challenged bone (e.g. large, aged or irradiated bone defects) tissue regeneration by mimicking the natural bone healing process. They are particularly interested in understanding the underlying the mechanisms by which osteogenic differentiation of the resident adult stem cells is regulated by micro-environmental cues during tissue injury and repair. Inspired by these fundamental findings, Dr. Sun's team is devoted to developing novel nano-biomaterials/drug delivery-based translational strategies for tissue engineering and regenerative medicine. Their long-term goal is to develop novel therapeutics for musculoskeletal related diseases, including large bone defects, vascular ossification, and cancer bone metastasis. Dr. Sun's current research interests include:

1. Promote endogenous bone formation by developing bio-mimicking nanofibrous 3D scaffolds;
2. Promote challenged bone repair by tailoring local drug delivery via injectable smart materials;
3. Study the role of adult stem cells and 3D microenvironment in bone metastasis.

Seminar Series

Each year we invite outstanding scientists to deliver research presentations that allow us the opportunity to increase our knowledge of the field and encourage collaborations and networking.

During the last academic year we were fortunate to host the following speakers:

David Oupicky, Ph.D.
Development of Pharmacologically Active Polymers to Target Chemokine Networks

Matthew Zimmerman, Ph.D.
Redox Signaling and Antioxidant-Based Therapeutics: Consequences for Hypertension

Anna Dunaevsky, Ph.D.
Neural Impairments in Mouse Models of Neurodevelopment Disorders

Shannon Buckley, Ph.D.
Regulation of Stem Cells by Ubiquitin E3 Ligase, FBXO9

Suzanne I. Sollars, Ph.D.
Variations in Plasticity of Rodent Gustatory and Somatosensory Systems across Development

Aaron Mohs, Ph.D.
Image Guidance in Surgical Oncology: Hyaluronic Acid Formulations of Near Infrared Fluorophores

Laura Bilek, Ph.D.
Relationship between Anthropometric Measures and Physical Activity with Bone Structure

Aleem Siddique, M.B.B.S.
Lungs in a Box – Can ex-vivo Perfusion Expand Donor Lung Utilization?

Amar Natrajan, Ph.D.
Targeting the "diseased state" of IKKbeta for Cancer Therapy

Bin Duan, Ph.D.
Engineering Approaches for Tissue Regeneration and Microphysiological Model Generation

Keely Buesing, M.D., F.A.C.S.
Alternative Oxygen Carriers for Treatment of Severe Ardis

Matthew MacEwan, Ph.D.
Transient Biomaterials for Regenerative Medical Applications

Xiaowei Li, Ph.D.
Bioengineering Approaches to Modulate Stem Cells for Tissue Regeneration

Brian Hong, Ph.D.
Computational Modeling of the Left Ventricle

Gus Wang, Ph.D.
Infectious Disease: Database Guided Design of Novel Antimicrobials and Antibiofilm Biomaterials

Nicholas Woods, Ph.D.
PDAC Proteomics: Molecular Subtype and Biomarker Discovery

Mark Carlson, M.D., F.A.C.S.
Large Animal Models of Cancer

Alexey Kamenskiy, Ph.D.
Pathology of Human Femoropopliteal Arteries

Babu Guda, Ph.D.
Exploring the Landscape of Fusion Transcripts in 33 Different Cancers

Soonjo Hwang, M.D.
Neurobiology-oriented Mechanism-targeted Clinical Trial in Psychiatry: e.g., Disruptive Mood and Behavior Disorders in Pediatric Population

John Davis, Ph.D.
The Formation and Regression of the Ovarian Corpus Luteum: Lessons for Tissue Remodeling

Jennifer Black, Ph.D.
Harnessing Tumor Suppressor Pathways for Cancer Therapy

Loretta Jophlin, M.D., Ph.D.
Lipid Droplets in Liver Disease

Yadong Wang, Ph.D.
All Roads Lead to Rome: Regeneration Using Biomaterials

Younan Xia, Ph.D.
Putting Electrospun Nanofibers to Work for Biomedical Research

Arup Indra, Ph.D.
Transcriptional Control of Skin Barrier Formation, Inflammation and Healing

Hongli Sun, Ph.D.
Bioinspired Nanomaterials for Bone Tissue Engineering

Vimla Band
Ecdysoneless, a Central Player in Oncogenesis

Quan Ly, M.D. and James E. Talmadge, Ph.D.
Adoptive Cellular Therapy for Pancreatic Cancer Treatment: bench to bedside

Jason MacTaggart
The Tortured Artery

Appendix A: New Publications

miR-29c regulates neurogliogenesis in the mammalian retina through REST. Xia X, Teotia P, **Ahmad I**. *Dev Biol.* 2019 Mar 23. pii: S0012-1606(19)30006-5. doi: 10.1016/j.ydbio.2019.03.013.

Trefoil factor(s) and CA19.9: A promising panel for early detection of pancreatic cancer. Jahan R, Ganguly K, Smith LM, Atri P, Carmicheal J, Sheinin Y, Rachagani S, Natarajan G, Brand RE, Macha MA, Grandgenett PM, Kaur S, **Batra SK**. *EBioMedicine.* 2019 Apr 4. pii: S2352-3964(19)30201-4. doi: 10.1016/j.ebiom.2019.03.056.

FDPS cooperates with PTEN loss to promote prostate cancer progression through modulation of small GTPases/AKT axis. Seshacharyulu P, Rachagani S, Muniyan S, Siddiqui JA, Cruz E, Sharma S, Krishnan R, Killips BJ, Sheinin Y, Lele SM, Smith LM, Talmon GA, Ponnusamy MP, Datta K, **Batra SK**. *Oncogene.* 2019 Mar 26. doi: 10.1038/s41388-019-0791-9.

Label-free characterization of exosome via surface enhanced Raman spectroscopy for the early detection of pancreatic cancer. Carmicheal J, Hayashi C, Huang X, Liu L, Lu Y, Krasnoslobodtsev A, Lushnikov A, Kshirsagar PG, Patel A, Jain M, Lyubchenko YL, Lu Y, **Batra SK**, Kaur S. *Nanomedicine.* 2019 Feb;16:88-96. doi: 10.1016/j.nano.2018.11.008. Epub 2018 Dec 11

Combination Therapies and Drug Delivery Platforms in Combating Pancreatic Cancer. Lei F, Xi X, **Batra SK**, Bronich TK. *J Pharmacol Exp Ther.* 2019 Feb 22. pii: jpet.118.255786. doi: 10.1124/jpet.118.255786

MicroRNA regulation of K-Ras in pancreatic cancer and opportunities for therapeutic intervention. Karmakar S, Kaushik G, Nimmakayala R, Rachagani S, Ponnusamy MP, **Batra SK**. *Semin Cancer Biol.* 2019 Feb;54:63-71. doi: 10.1016/j

Phosphorylation of Cx43 residue Y313 by Src contributes to blocking the interaction with Drebrin and disassembling gap junctions. Zheng L, Li H, Cannon A, Trease AJ, Spagnol G, Zheng H, Radio S, Patel K, **Batra S**, Sorgen PL. *J Mol Cell Cardiol.* 2019 Jan;126:36-49. doi: 10.1016/j.yjmcc.2018.11.008. Epub 2018 Nov 15.

Systems Biology Approach to Identify Novel Genomic Determinants for Pancreatic Cancer Pathogenesis. Khatri I, Ganguly K, Sharma S, Carmicheal J, Kaur S, **Batra SK**, Bhasin MK. *Sci Rep.* 2019 Jan 15;9(1):123. doi: 10.1038/s41598-018-36328-w

Cancer-associated mucins: role in immune modulation and metastasis. Bhatia R, Gautam SK, Cannon A, Thompson C, Hall BR, Aithal A, Banerjee K, Jain M, Solheim JC, Kumar S, **Batra SK**. *Cancer Metastasis Rev.* 2019 Jan 8. doi: 10.1007/s10555-018-09775-0. [Epub ahead of print] Review

Dual delivery nanoscale device for miR-345 and gemcitabine co-delivery to treat pancreatic cancer. Uz M, Kalaga M, Pothuraju R, Ju J, Junker WM, **Batra SK**, Mallapragada S, Rachagani S. *J Control Release.* 2019 Jan 28;294:237-246. doi: 10.1016/j.jconrel.2018.12.031. Epub 2018 Dec 18

Unraveling the journey of cancer stem cells from origin to metastasis. Nimmakayala RK, **Batra SK**, Ponnusamy MP. *Biochim Biophys Acta Rev Cancer.* 2019 Jan;1871(1):50-63. doi: 10.1016/j.bbcan.2018.10.006. Epub 2018 Nov 9.

Pancreatic cancer associated with obesity and diabetes: an alternative approach for its targeting. Pothuraju R, Rachagani S, Junker WM, Chaudhary S, Saraswathi V, Kaur S, **Batra SK**. *J Exp Clin Cancer Res.* 2018 Dec 19;37(1):319. doi: 10.1186/s13046-018-0963-4

Novel role of O-glycosyltransferases GALNT3 and B3GNT3 in the self-renewal of pancreatic cancer stem cells. Barkeer S, Chugh S, Karmakar S, Kaushik G, Rauth S, Rachagani S, **Batra SK**, Ponnusamy MP. *BMC Cancer.* 2018 Nov 22;18(1):1157. doi: 10.1186/s12885-018-5074-2

Disruption of C1galt1 Gene Promotes Development and Metastasis of Pancreatic Adenocarcinomas in Mice. Chugh S, Barkeer S, Rachagani S, Nimmakayala RK, Perumal N, Pothuraju R, Atri P, Mahapatra S, Thapa I, Talmon GA, Smith LM, Yu X, Neelamegham S, Fu J, Xia L, Ponnusamy MP, **Batra SK**. *Gastroenterology.* 2018 Nov;155(5):1608-1624. doi: 10.1053/j.gastro.2018.08.007. Epub 2018 Aug 4.

Macrophage-Derived Neuropilin-2 Exhibits Novel Tumor-Promoting Functions. Roy S, Bag AK, Dutta S, Polavaram NS, Islam R, Schellenburg S, Banwait J, Guda C, Ran S, Hollingsworth MA, Singh RK, Talmadge JE, Muders MH, **Batra SK**, Datta K. *Cancer Res.* 2018 Oct 1;78(19):5600-5617. doi: 10.1158/0008-5472.CAN-18-0562. Epub 2018 Aug 15.

PD-L1, inflammation, non-coding RNAs, and neuroblastoma: Immuno-oncology perspective. Nallasamy P, Chava S, Verma SS, Mishra S, Gorantla S, Coulter DW, Byrareddy SN, **Batra SK**, Gupta SC, Challagundla KB. *Semin Cancer Biol.* 2018 Oct;52(Pt 2):53-65. doi: 10.1016/j.semcancer.2017.11.009. Epub 2017 Nov 28

Cigarette Smoke Induces Stem Cell Features of Pancreatic Cancer Cells via PAF1. Nimmakayala RK, Seshacharyulu P, Lakshmanan I, Rachagani S, Chugh S, Karmakar S, Rauth S, Vengoji R, Atri P, Talmon GA, Lele SM, Smith LM, Thapa I, Bastola D, Ouellette MM, **Batra SK**, Ponnusamy MP. *Gastroenterology.* 2018 Sep;155(3):892-908.e6. doi: 10.1053/j.gastro.2018.05.041. Epub 2018 Jun 2

Glycosylation of Cancer Stem Cells: Function in Stemness, Tumorigenesis, and Metastasis. Barkeer S, Chugh S, **Batra SK**, Ponnusamy MP. *Neoplasia.* 2018 Aug;20(8):813-825. doi: 10.1016/j.neo.2018.06.001. Epub 2018 Jul 6

MASTL induces Colon Cancer progression and Chemoresistance by promoting Wnt/β-catenin signaling. Uppada SB, Gowrikumar S, Ahmad R, Kumar B, Szeglin B, Chen X, Smith JJ, **Batra SK**, Singh AB, Dhawan P. *Mol Cancer.* 2018 Aug 1;17(1):111. doi: 10.1186/s12943-018-0848-3

Axed MUC4 (MUC4/X) aggravates pancreatic malignant phenotype by activating integrin-β1/FAK/ERK pathway. Jahan R, Macha MA, Rachagani S, Das S, Smith LM, Kaur S, **Batra SK**. *Biochim Biophys Acta Mol Basis Dis.* 2018 Aug;1864(8):2538-2549. doi: 10.1016/j.bbadis.2018.05.008. Epub 2018 May 16.

Appendix A: New Publications

p66Shc regulates migration of castration-resistant prostate cancer cells. Ingersoll MA, Chou YW, Lin JS, Yuan TC, Miller DR, Xie Y, Tu Y, Oberley-Deegan RE, **Batra SK**, Lin MF. *Cell Signal.* 2018 Jun;46:1-14. doi: 10.1016/j.cellsig.2018.02.008. Epub 2018 Feb 17.

Crosstalk between PKCα and PI3K/AKT Signaling Is Tumor Suppressive in the Endometrium. Hsu AH, Lum MA, Shim KS, Frederick PJ, Morrison CD, Chen B, Lele SM, Sheinin YM, Daikoku T, Dey SK, Leone G, Black AR, **Black JD**. *Cell Rep.* 2018 Jul 17;24(3):655-669. doi: 10.1016/j.celrep.2018.06.067

TGFβ and IGF1R signaling activates protein kinase A through differential regulation of ezrin phosphorylation in colon cancer cells. Leiphrakpam PD, Brattain MG, **Black JD**, Wang J. *J Biol Chem.* 2018 May 25;293(21):8242-8254. doi: 10.1074/jbc.RA117.001299

Fabrication of injectable and superelastic nanofiber rectangle matrices ("peanuts") and their potential applications in hemostasis. Chen S, **Carlson MA**, Zhang YS, Hu Y, Xie J. *Biomaterials.* 2018 Oct;179:46-59. doi: 10.1016/j.biomaterials.2018.06.031. Epub 2018 Jun 22.

Evaluation of cellular ingrowth within porcine extracellular matrix scaffolding in congenital heart disease surgery. Cox JL, **Hammel JM**, Radio SJ. *Cardiovasc Pathol.* 2019 Mar - Apr;39:54-60. doi: 10.1016/j.carpath.2018.12.003. Epub 2018 Dec 21.

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Left Ventricular Assist Devices In Pulmonary Hypertension Group 2 With Significantly Elevated Pulmonary Vascular Resistance: A Bridge To Cure. Selim AM, Wadhwani L, Burdorf A, Raichlin E, **Lowes B**, Zolty R. *Heart Lung Circ.* 2018 May 18. pii: S1443-9506(18)30489-X. doi: 10.1016/j.hlc.2018.04.299.

Mechanical damage characterization in human femoropopliteal arteries of different ages. Anttila E, Balzani D, Desyatova A, Deegan P, **MacTaggart J**, **Kamenskiy A**. *Acta Biomater.* 2019 Mar 28. pii: S1742-7061(19)30229-6. doi: 10.1016/j.actbio.2019.03.053.

Nitinol Stents in the Femoropopliteal Artery: A Mechanical Perspective on Material, Design, and Performance. Maleckis K, Anttila E, Aylward P, Poulson W, Desyatova A, **MacTaggart J**, **Kamenskiy A**. *Ann Biomed Eng.* 2018 May;46(5):684-704. doi: 10.1007/s10439-018-1990-1. Epub 2018 Feb 22. Review.

Prophylactic cholecystectomy in short bowel syndrome: Is it being utilized? Thompson JS, **Mercer DF**, Vargas LM, Grant WJ, Rochling FA, Langnas AN. *Am J Surg.* 2018 Jul;216(1):73-77. doi: 10.1016/j.amjsurg.2018.04.002. Epub 2018 Apr 27.

Model for prioritization of Graduate Medical Education funding at a university setting - Engagement of GME committee with the Clinical Enterprise. Are C, Suh M, Carpenter L, Stoddard H, Hamm V, DeVries M, Goldner W, Jarzynka K, Parker J, Simonson J, Talmon G, Vokoun C, Gold J, **Mercer D**, Wadman M. *Am J Surg.* 2018 Jul;216(1):147-154. doi: 10.1016/j.amjsurg.2017.07.010. Epub 2017 Jul 19

Quantification of Daily Physical Activity and Sedentary Behavior of Claudicating Patients. Hernandez H, **Myers SA**, Schieber M, Ha DM, Baker S, Koutakis P, Kim KS, Mietus C, Casale GP, **Pipinos II**. *Ann Vasc Surg.* 2019 Feb;55:112-121. doi: 10.1016/j.avsg.2018.06.017. Epub 2018 Aug 13

Tumor-Associated Neutrophils in Cancer: Going Pro. Wu L, Saxena S, Awaji M, **Singh RK**. *Cancers (Basel).* 2019 Apr 19;11(4). pii: E564. doi: 10.3390/cancers11040564. Review.

Cancer-Associated Fibroblasts Enhance Survival and Progression of the Aggressive Pancreatic Tumor Via FGF-2 and CXCL8. Awaji M, Futakuchi M, Heavican T, Iqbal J, **Singh RK**. *Cancer Microenviron.* 2019 Apr 26. doi: 10.1007/s12307-019-00223-3.

Cancer-Associated Fibroblasts' Functional Heterogeneity in Pancreatic Ductal Adenocarcinoma. Awaji M, **Singh RK**. *Cancers (Basel).* 2019 Mar 1;11(3). pii: E290. doi: 10.3390/cancers11030290. Review

CXCR2: A Novel Mediator of Mammary Tumor Bone Metastasis. Sharma B, Nannuru KC, Saxena S, Varney ML, **Singh RK**. *Int J Mol Sci.* 2019 Mar 12;20(5). pii: E1237. doi: 10.3390/ijms20051237

Semaphorin-5A maintains epithelial phenotype of malignant pancreatic cancer cells. Saxena S, Purohit A, Varney ML, Hayashi Y, **Singh RK**. *BMC Cancer.* 2018 Dec 22;18(1):1283. doi: 10.1186/s12885-018-5204-x.

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A Macromolecular Janus Kinase (JAK) Inhibitor Prodrug Effectively Ameliorates Dextran Sulfate Sodium-Induced Ulcerative Colitis in Mice. Zhao G, Wei X, Wu J, Eichele DD, Lele SM, Yang L, Zhang F, **Wang D**. *Pharm Res.* 2019 Mar 11;36(4):64. doi: 10.1007/s11095-019-2587-6

Mineralized nanofiber segments coupled with calcium-binding BMP-2 peptides for alveolar bone regeneration. Boda SK, Almoshari Y, Wang H, Wang X, Reinhardt RA, Duan B, **Wang D**, Xie J. *Acta Biomater.* 2019 Feb;85:282-293. doi: 10.1016/j.actbio.2018.12.051. Epub 2018 Dec 31

Bone-targeting liposome formulation of Salvianic acid A accelerates the healing of delayed fracture Union in Mice. Liu Y, Jia Z, Akhter MP, Gao X, Wang X, Wang X, Zhao G, Wei X, Zhou Y, Wang X, Hartman CW, Fehringer EV, Cui L, **Wang D**. *Nanomedicine.* 2018 Oct;14(7):2271-2282. doi: 10.1016/j.nano.2018.07.011. Epub 2018 Aug 2.

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Manufacturing human pluripotent stem cell derived endothelial cells in scalable and cell-friendly microenvironments. Lin H, Du Q, Li Q, Wang O, Wang Z, Elowsky C, Liu K, Zhang C, Chung S, **Duan B**, **Lei Y**. *Biomater Sci.* 2018 Dec 18;7(1):373-388. doi: 10.1039/c8bm01095a

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Appendix A: New Publications

Mineralized nanofiber segments coupled with calcium-binding BMP-2 peptides for alveolar bone regeneration. Boda SK, Almoshari Y, Wang H, Wang X, Reinhardt RA, Duan B, Wang D, **Xie J**. *Acta Biomater.* 2019 Feb;85:282-293. doi: 10.1016/j.actbio.2018.12.051. Epub 2018 Dec 31.

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Pneumatic microfluidic cell compression device for high-throughput study of chondrocyte mechanobiology. Lee D, Erickson A, You T, **Dudley AT**, Ryu S. *Lab Chip.* 2018 Jul 10;18(14):2077-2086. doi: 10.1039/c8lc00320c

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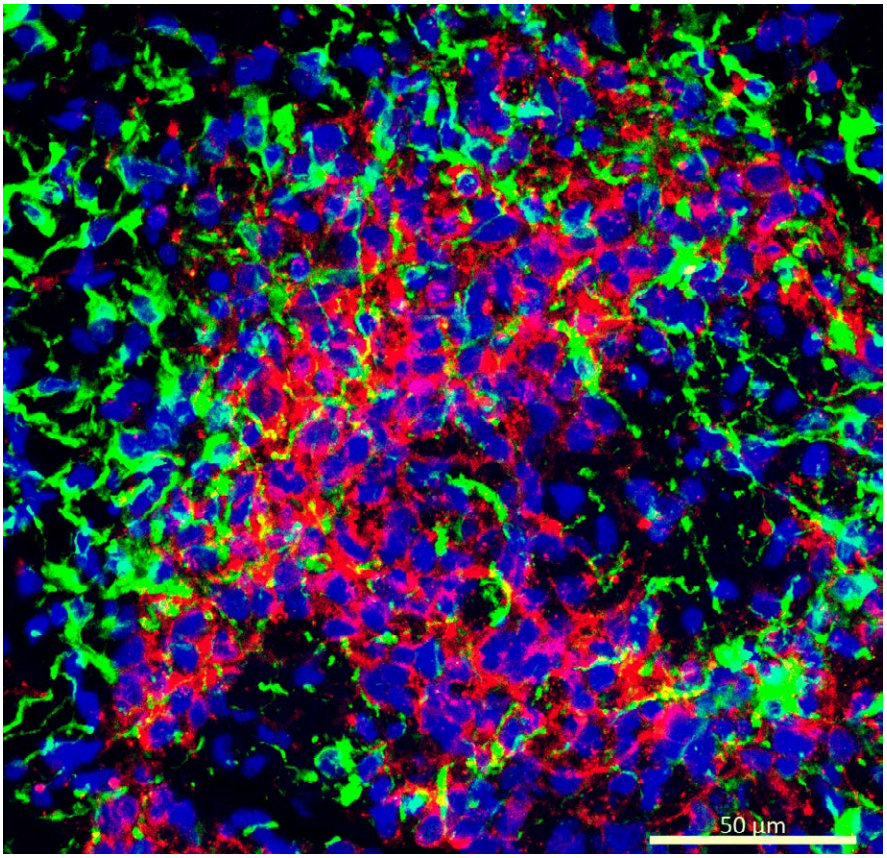
Appendix B: New Patents & Inventions

1. Xie J, Zhang X, A Method of Engineering Off-the-Shelf Structural Bone Allograft, UNMC NIN No. 19051.
2. Xie J, Johnson VJ, A Method of Producing Porous and/or Hollow Nanofiber Microspheres/ Microparticles, UNMC NIN No. 19027.
3. Carlson M, Xie J, Multi-layer Hernia Meshes, US provisional patent 62665794, 2018.
4. Xie J, Boda SK, Therapeutic Short Nanofiber Fragments, U.S. provisional patent 62661174, 2018. PCT application filed in 2019.
5. Xie J, Boda SK, Nanofiber Microspheres, U.S. provisional patent 62661171, 2018.
6. Xie J, Chen S, A Method to Generate Shape Recoverable/ Memorable 3D nanofiber Scaffolds with Complex Shapes and Orders, U.S. Provisional patent 62616489, 2018.
7. Duan, B, Shi, W, Mirza, S, Band, V, Engineered Hydrogel for Cell and Organoid 3D Culture, U.S. provisional patent 62827334, docket 19058P.
8. Duan, B, Shi, W, Li, Yulong, Zhang, D, Versatile Injectable Hydrogels for Drug Delivery, Cell Culture and Delivery and 3D Printing, UNMC NIN No. 19087.



Appendix C: Staff & Student Recognition

Staff

In December 2018, the Regenerative Medicine team participated in a holiday event which included collecting gifts for those who need them the most due to medical illnesses affecting their families. The team "adopted" a family to purchase gifts for and then gathered to wrap presents and celebrate the holiday season and teamwork. Gifts were then turned over to Nebraska Medicine social workers who presented the gifts to the family.

The Regenerative Medicine team.

Students

Huh Lab

The Huh Lab is currently hosting two graduate students, Yuetong Zhao and Brennan Roche.

Duan Lab

The Duan Lab is currently hosting Yunfan Kong and Xiping Jiang.

Dudley Lab

The Dudley Lab is currently hosting Stephen Haller and Sydney Greer.

Xie Lab

The Xie lab is currently hosting Alec McCarthy.

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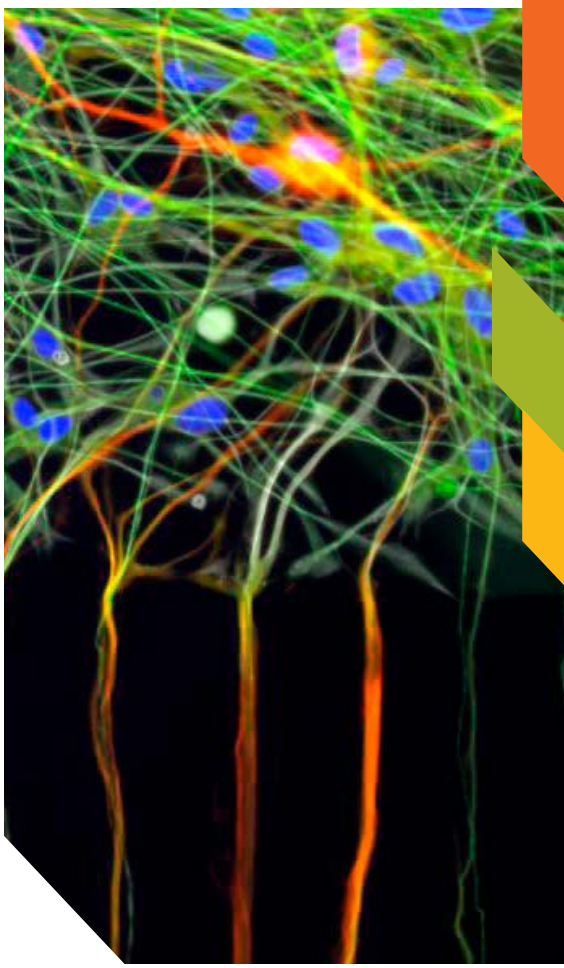

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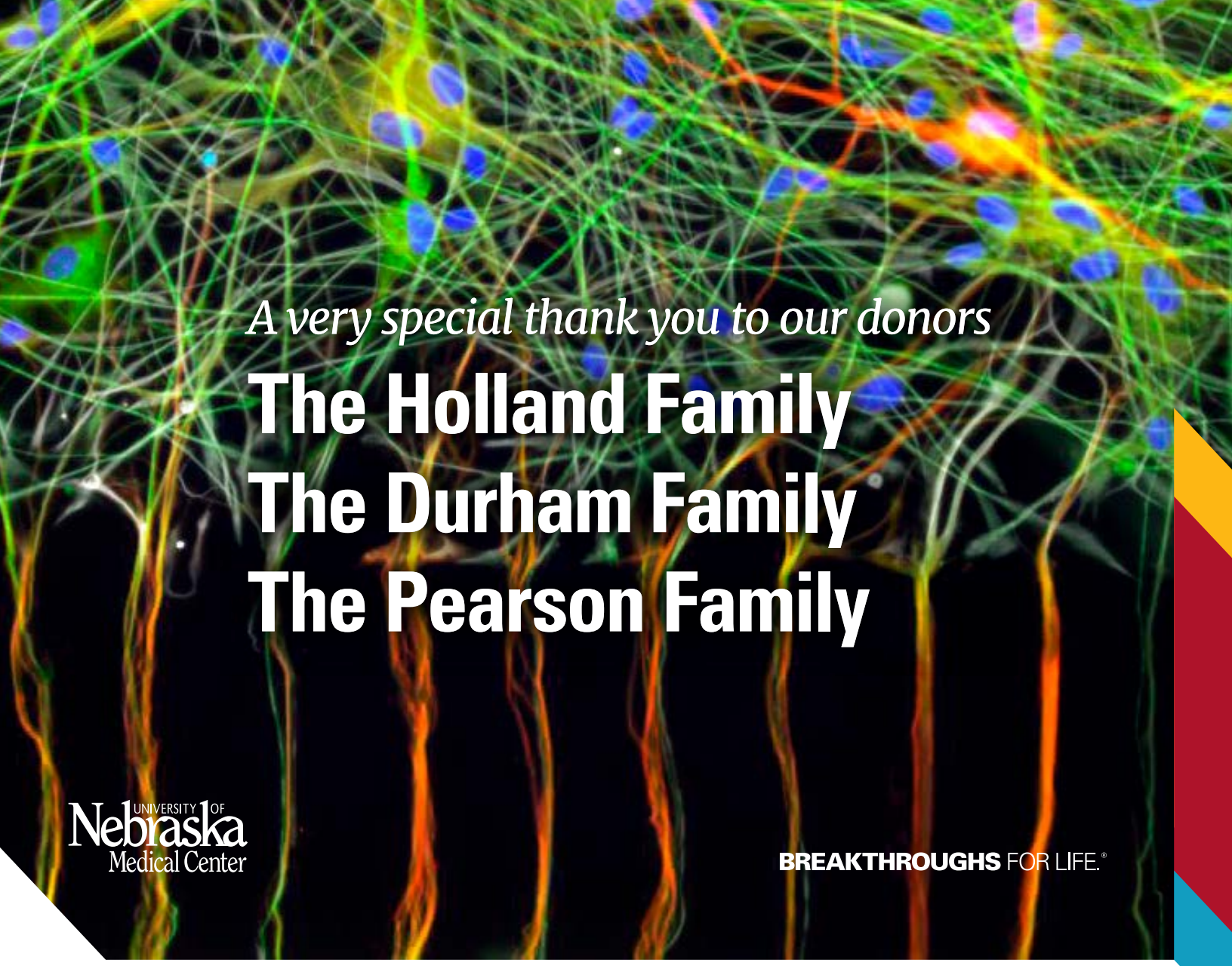

Save the Date – Fall Conference

Adipose and Mesenchymal Stem Cell Differentiation and Utility for Tissue Regeneration

Wednesday, September 18, 2019

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