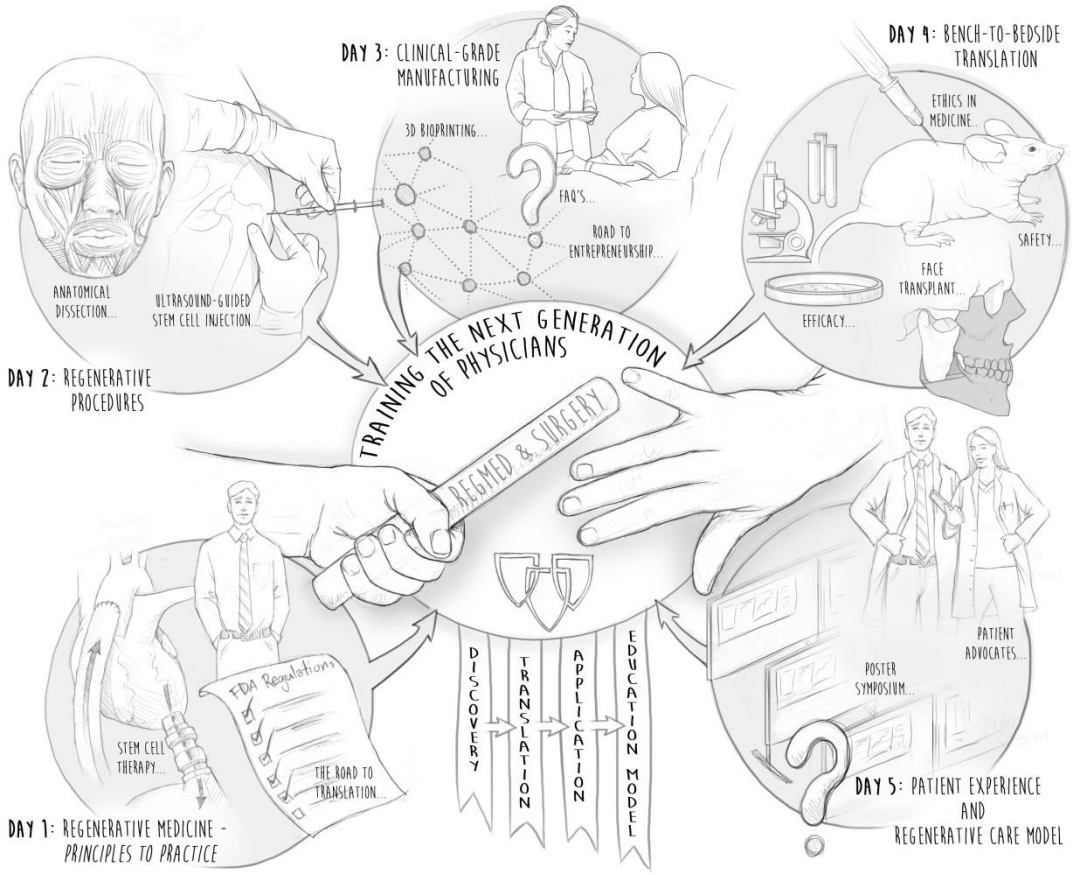
Regenerative Medicine Minnesota
Progress Report

Grant Title: Minnesota Medical Student Guide to Proficiency in Regenerative Medicine and Surgery
Grant Number: RMM-2016-EP-07
Requester: Saranya P. Wyles, M.D., Ph.D.
Project Timeline: June 1, 2016 – May 30, 2017

Brief description of project:

Advances in medicine are constant and impact how medicine is taught and defined. In collaboration with the Mayo Clinic Center for Regenerative Medicine, the Regenerative Medicine and Surgery Selective (RMSS) was launched in 2014 at Mayo Clinic School of Medicine and has been a successful education program for first-year medical students. Learning objectives centered on achieving proficiency in (1) Principles and Practice of Regenerative Medicine, (2) Regenerative Procedures, (3) Bench-to-Bedside Translation, (4) Clinical-Grade Manufacturing, and (5) Patient Experience and Regenerative Care Model. Participation in the RMSS at Mayo Clinic School of Medicine increases medical student awareness of regenerative medicine model of healthcare and contributes to specialty identification, research engagement, and clinical practice.

Inaugural funding from Regenerative Medicine Minnesota (2016-2017) allowed us to engage over 40 medical students from across Minnesota (n=32 trainees from Mayo Clinic School of Medicine; n=10 trainees from University of Minnesota Medical School – Twin Cities and Duluth). Five medical students were also funded to attend the 2016 World Stem Cell Summit for poster presentations and networking opportunities. Activities of prior RMSS alumni include Clinical and Translational Science (CCaTS) Master's Degrees (n=3), Howard Hughes Medical Institute (HHMI) Research Fellowship (n=1), Fulbright Fellowship Finalist (n=1) and Ph.D. thesis work (n=5) in regenerative medicine research. Regenerative medicine is an investment in the future of healthcare. Early incorporation into mainstream medical education offers a paradigm of training next-generation healthcare professionals equipped to adopt and deliver regenerative medicine solutions.



Where did this project take place?

Regenerative Medicine and Surgery Selective (RMSS) takes place at Mayo Clinic in Rochester, Minnesota. This selective is aimed to address the educational gap in the medical school curriculum and provides an opportunity for students to engage in lectures and hands-on techniques from current faculty members that are actively addressing questions of human health and disease using the tools of regenerative medicine. Given the diversity of experiences, medical trainees are exposed to various locations in the Mayo Clinic campus (Medical Anatomy – Cadaver Laboratory, Cardiac Regeneration Program – Stem Cell Laboratory, Animal Surgical Suites and Catheterization Laboratory, Mayo Clinic Simulation Center – Regenerative Medicine Consult Service, Human Cell Therapy Laboratory, Mayo Clinic Biotrust – Stem Cell Banking, Mayo Clinic School of Medicine – Guggenheim and Charlton Lecture Hall).

People impacted by project and where they are from:

Funding from Regenerative Medicine Minnesota allowed us to host 42 medical trainees from Mayo Clinic School of Medicine (n=32) and University of Minnesota Medical School – Twin Cities and Duluth (n=10).

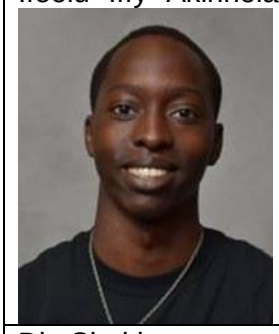
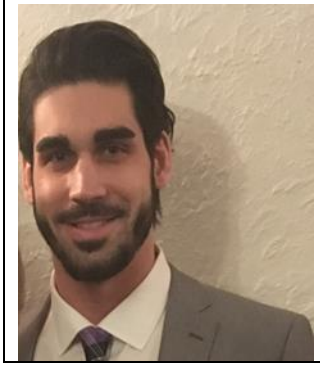
RMSS alumni also participated in poster presentations at the World Stem Cell Summit.

Medical Trainee	**Brief Biography**	**Research Interest / Poster Title**
Claudia Gutierrez 	Claudia, a second-year medical student, is interested in a career that bridges engineering with medicine. She aspired to be a surgeon that collaborates with biomedical researchers. Since starting medical school she has become interested in regenerative medicine related to the field of reconstructive surgery. She is planning to take a year off at the end of her second year of medical school to complete a year of research in the field of bone tissue engineering at the University Hospital of Basel in Switzerland.	*Proteomic Analysis of Formalin-Fixed Paraffin-Embedded Tissue Sections Reveals Niche Effects in Mesenchymal Stem Cell Model of Medialization Laryngoplasty*

Medical Trainee	Brief Biography	Research Interest / Poster Title
Mark Li 	Mark is a third-year MD/PhD student in the Medical Scientist Training Program at Mayo Clinic. He is currently working in the Cardiac Regeneration Program, with his doctoral thesis focusing on the student of cell-free therapies for the regeneration of heart after ischemic injury. Mark studies biomedical engineering at University of Toronto in Canada.	*Cardiac Cell Programming Using Microencapsulated-modified-messenger (M3) RNA*
Erin Triplet 	Erin is an MD/PhD student currently in her first year of graduate school. She is originally from Watertown, South Dakota. Erin graduated summa cum laude from Creighton University in 2014 with B.S. Biology. Erin's career goals include clinical practice in Neurology and exploring the hope and promise of regenerative medicine techniques.	*iPSC-derived Oligodendrocyte Precursor Cells as a Therapy for Optic Neuritis*
Rosalie Sterner 	Rosalie Sterner is an MD/PhD student in the Mayo Medical Scientist Training Program. Her PhD project focuses on characterizing the protective bone marrow microenvironment that prevents standard chemotherapeutics from eradicating malignant acute myelogenous leukemia cells. Being able to attend the World Stem Cell Summit will be a great opportunity for her to see the connections between basic science, translational, and clinical research in action and to learn more about the stem cell field to potentially apply new ideas to her own work.	*Manipulating differentiation of cells of mesenchymal origin in the endosteal niche to inhibit protection of AML cells* ***Best Poster Award*
Praveena Narayanan 	Praveena is a fourth-year medical student from Wisconsin, pursuing residency in internal medicine with an ultimate career interest in transplant medicine. She has been engaged in research on both the outcomes of liver transplant and the role of medical education in hematopoietic stem cell transplant. She looks forward to attending the 2016 World Stem Cell Summit to learn about advancements in the field; in particular, the potential of stem cells as alternatives for organ transplantation.	*Medical students' knowledge, familiarity, and attitudes towards hematopoietic stem cell donation: stem cell donation behaviors*

Ten medical students from the University of Minnesota Medical School – Twin Cities and Duluth participated in the 2016-2017 RMSS opportunity. Below student biography and interest:

Medical Trainee	**Brief Biography / Interest in Regenerative Medicine**
Anja Swenson 	Anja is currently a second-year MD/PhD student at the University of Minnesota. Prior to beginning medical school, she spent three years working at Penn State College of Medicine. There she developed an interest in the structural impacts of genetic cardiomyopathies at the sarcomere, cardiomyocyte, and single molecule level. She continues to explore these interests as an MSTP student studying ensemble interactions of cardiac myosin. Her long-term goal is to elucidate the mechanisms by which hypertrophic cardiomyopathy mutations modulate sarcomeric function, a crucial step toward the development of small molecule therapeutics.
Dolan Lee 	Dolan is a second-year medical student at the University of Minnesota Medical School. Dolan grew up in Los Angeles, CA and Edina, MN, and is interested in the intersection of business and medicine. When not studying, Dolan enjoys swimming, nature hikes, and staying active. Dolan graduated from Northwestern University with a B.A. in Genetics & Molecular Biology and a minor in Business Institutions.
Joohee Han 	Joohee is a fourth-year medical student and will be a Plastic and Reconstructive Surgery resident at the University of Minnesota next year. Born and raised in Seoul, South Korea, she has been introduced to and immersed in Korean Plastic Surgery at a young age and has been pursuing her dream to deliver the highest quality patient care for more than 17 years. The Regenerative Medicine and Surgery Course at Mayo Clinic School of Medicine will be an important component to her professional development and play a vital part in achieving her goal to become a well-rounded plastic and reconstructive surgeon.
Chen Chen 	Chen is a third year medical student from University of Minnesota – Twin Cities Campus interested in OB/GYN. She grew up in China and graduated from University of Minnesota-Morris. Besides being a first lieutenant of U.S. Army MN National Guard, she is also a certified yoga sculpt teacher, an amateur pianist, and a cat mom. She is interested in learning more about regenerative medicine, specifically in regenerative medicine application in organ transplantation.
Jacob Bermudez 	Jacob is a third year medical student at the University of Minnesota Medical School. He was born and raised in Chicago. He completed his undergraduate education at the University of Illinois and his graduate education at the University of Michigan. He loves the outdoors, and fast cars. He cheers for Chicago sports team even when they don't win for years on end. Before coming to Minnesota for medical school he worked as a clinical integrations specialist in Los Angeles. He is excited to be part of this new regenerative medicine course, and looking forward to learning all sorts of interesting new information.

Mayank Verma 	Mayank is an MD/PhD student at the University of Minnesota Medical School. His long-term career goals are to become a physician-scientist with a joint appointment in a clinical Neuromuscular Medicine as well as basic science department. His scientific interests lie in studying the interaction between the various cell types found in the skeletal muscle in the context of muscle disease and applying these findings to improvement of current and new therapies. For his graduate school dissertation, he is working to identify the role of the vasculature in the tissue resident muscle stem cell population and their role in the disease process in Duchenne muscular dystrophy.
Kyle Lau 	Kyle is a first-year medical student at the University of Minnesota School Duluth. He is from Cloquet, MN and is interested in family medicine. His previous research experiences include discovering new antimicrobial peptides to combat multidrug resistant pathogens along with finding causative genomic factors of rare diseases. He is interested in regenerative medicine because of the opportunities of treating diseases we previously could only address the symptoms. It is amazing how we can potentially utilize a patient's cells to replace damaged cells that typically do not replicate like in diseases such as Alzheimer's and Diabetes. He is looking forward to participating in the Regenerative Medicine course.
Ifeolu "Iffy" Akinnola 	Iffy is from Burtonsville, MD and went to University of Maryland, Baltimore County for college. He is currently enrolled in the MD/PhD program at University of Minnesota - Integrative Biology & Physiology. Early on in grade school he became interested in the benefit modern medicine provides for people's quality of life. He joined a tissue engineering lab focused on whole lung decellularization and recellularization as well as 3-D bioprinting. He studies reinstitution of vascular endothelium in decellularized lung scaffolds. He plans to advance his knowledge of regenerative medicine and become an expert in the field.
Dip Shukla 	Dip is a second-year medical student at the University of Minnesota Medical School. His undergraduate education in biochemistry and genetics at the University of Minnesota instilled a strong interest in basic science research as well as its potential for medical application. He has a growing interest in molecular biology and genome engineering, specifically in terms of their application towards gene therapy and regenerative medicine. In the future, he aspires to incorporate elements of research and clinical practice into his career to improve treatment options and patient outcomes.
Sacha Paul Broccard 	Sacha is a third-year medical student at the University of Minnesota, Twin Cities campus. He was born in Lausanne, Switzerland and emigrated in 2001 settling in Bloomington, Minnesota. He studied at Lafayette College where he perused Biology and Economics while competing at the Division I level as captain of the swimming team. His interests are in general surgery and critical care physiology. The introduction and recent increased use of synthetic and biosynthetic products in surgery make regenerative medicine especially interesting.

What was the outcome of the project? (Did the project work the way you expected it to? What were the successes? What were the failures? How did it impact regenerative medicine in Minnesota?)

Statewide expansion of regenerative medicine education was achieved by participation of physicians-in-training in the one-week patient-centered curriculum at Mayo Clinic School of Medicine. Successful implementation of this proposal has engaged over 40 medical trainees across Minnesota in the principles of regenerative medicine that are rapidly transforming the clinical practice. Participation in the RMSS at Mayo Clinic School of Medicine increased medical student awareness of regenerative medicine model of healthcare and contributed to specialty identification, research engagement, and clinical practice. Activities of prior RMSS alumni include Clinical and Translational Science (CCaTS) Master's Degrees (n=3), Howard Hughes Medical Institute (HHMI) Research Fellowship (n=1), Fulbright Fellowship Finalist (n=1) and Ph.D. thesis work (n=5) in regenerative medicine research.

Challenges in implementation included scheduling the course between two medical school curriculums. Ideally, we aimed to enroll first-year medical trainees in order to expose them to a variety of regenerative medical and surgical specialties early in training. April has been identified as an ideal time for this selective in the Mayo Clinic medical curriculum; however this timing is not ideal for University of Minnesota medical students in their first year. Instead, second year medical students and students in MD-PhD training enrolled from University of Minnesota. Many of these students valued this course and have expressed their interest in serving as an educational liaison for their school. With their partnership, we are planning to host entrepreneurship in regenerative sciences workshops at University of Minnesota and Mayo Clinic to engage more medical trainees. Additionally, longitudinal exposure to the regenerative medicine model of healthcare is important; partnership with the current RMSS alumni in University of Minnesota will allow us to better facilitate these ongoing educational opportunities and further expand our goals.

In summary, the Regenerative Medicine and Surgery Selective impacted regenerative medicine in Minnesota by developing the next-generation physician workforce and encouraging future physicians to participate in pioneering curative therapies.

Please list any of the following that have resulted from your RMM grant funding:

- Publications and/or manuscripts submitted for publication
    - Manuscript (*in preparation*): Regenerative Medicine and Surgery: A Next-Generation Medical School Curriculum.
- Other grant applications and/or awards
    - Invited Lecture: *Novel Education Pathways*. 12th World Stem Cell Summit.
    - Poster Presentation: *Medical Student Guide to Proficiency in Regenerative Medicine and Surgery: The Mayo Clinic Experience.* 2017 International Society for Stem Cell Research.
    - Invited Lecture: *Education Pathway in Regenerative Medicine: Building the Next-Generation Workforce.* Symposium on Stem Cell Therapy and Cardiovascular Innovations.

Responsible Spending:

Please let us know how you spent the money. Any unspent funds must be returned.

Inaugural funding from Regenerative Medicine Minnesota allowed us to achieve our specific aims listed in the proposal. To facilitate our efforts for statewide expansion, the majority of the expenses were towards hosting the selective in April 2017; these included UMN student housing and travel stipends, on-site food and catering, and specific laboratory experiences. Furthermore, this award allowed medical student RMSS alumni to present their research projects at the 2016 World Stem Cell Summit. A portion of our RMM funding was returned since our goal to publish a medical-student handbook in regenerative sciences is still in progress. Our funding proposal for 2017-2018 was renewed and we plan to continue our efforts to expand this medical curriculum.

Description	**Final Cost**
Total Direct Cost	$38,758
Symposium expenses, travel awards and cost to administer the pilot program	
Indirect Cost	$22,867
TOTAL	$61,625
REMAINING BALANCE (Returned to RMM)	$38,375