

## Regenerative Medicine Minnesota Progress Report

**Grant Title:** Minnesota Medical Student Guide to Proficiency in Regenerative Medicine and Surgery

**Grant Number:** RMM-2017-EP-05

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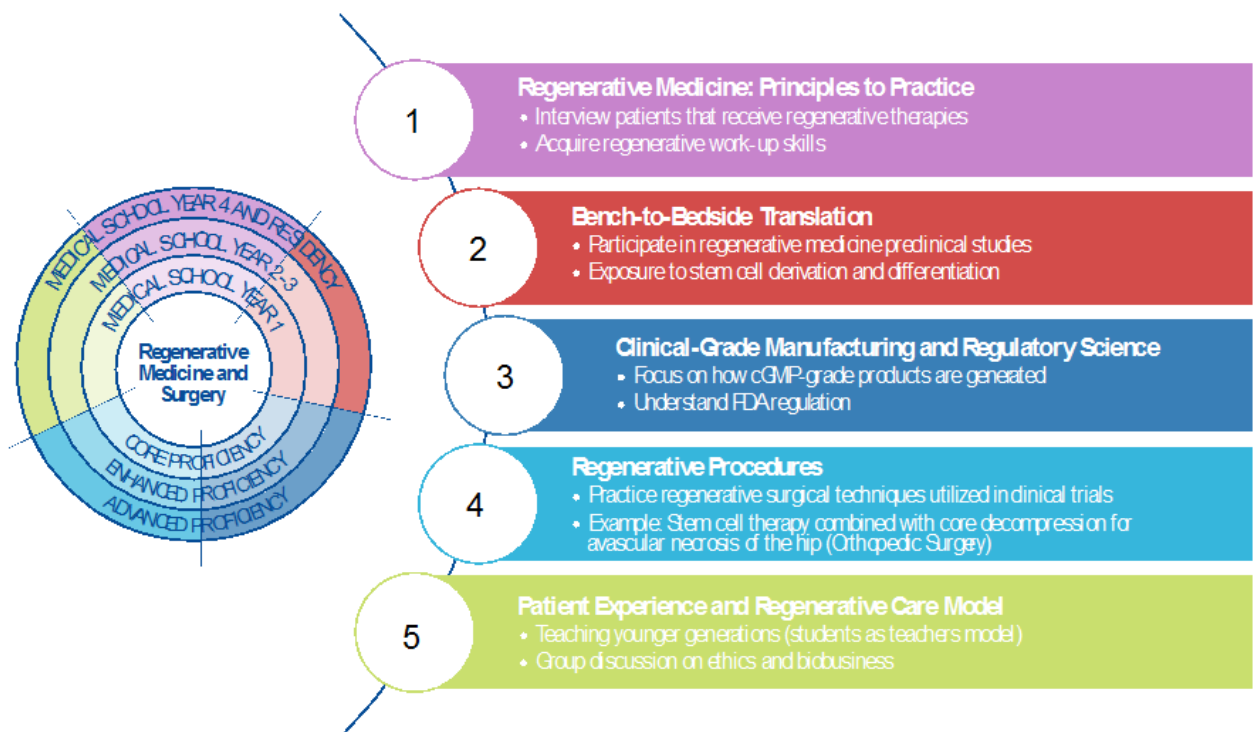
**Project Timeline:** June 1, 2017 – May 30, 2018

### Brief description of project:

Regenerative medicine holds unprecedented potential for future healthcare, necessitating continuing educational opportunities for students and faculty in medical professions. Mayo Clinic Center of Regenerative Medicine and the University of Minnesota Stem Cell Institute are committed to educating young investigators, patients, and the public about the basics of and latest advances in stem cell biology and regenerative medicine. The 'Regenerative Medicine and Surgery Course' was launched in 2014 at Mayo Clinic School of Medicine and has been a successful education program for first-year medical students. The goal of this course is to integrate regenerative medicine education in the medical curriculum to promote physicians-in training to think differently using a restorative approach to healthcare.

The one-week course was strategically designed to encompass the Principles and Practice of Regenerative Medicine (Day 1), Regenerative Procedures (Day 2), Bench-to-Bedside Translation (Day 3), Clinical-Grade Manufacturing (Day 4), and Patient Experience and Regenerative Care Model (Day 5). Course content encompasses specific educational objectives such as understanding fundamental regenerative medicine principles, describing surgical techniques utilized in clinical trials, recognizing the importance of preclinical models for testing feasibility, safety and efficacy and ultimately recognizing the steps to bring discovery into the clinic through commercialization and community outreach.

Continued funding from Regenerative Medicine Minnesota (2016-2018) allowed us to engage nearly 300 students and faculty across Minnesota. Launched in 2014, **a total of 151 medical students, 82 high school students, 8 visiting research fellows and 55 faculty members** have participated in this novel bench-to-bedside curriculum. Participation in the RMSS increases medical trainee awareness of regenerative medicine model of healthcare and contributes to specialty identification, research engagement and clinical practice.



## 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). This year, we hosted “Meet the Experts: Speed Networking” at University of Minnesota Stem Cell Institute in Minneapolis, MN.

Education outreach activities for minority groups in Minnesota have taken place at “Minnesota Indian Education Association” (November 2017) in Treasure Island Casino, Welch, MN and “Science Fusion: American Indians in Science” (January 2018) in Science Museum of Minnesota, St. Paul, MN.

## People impacted by project and where they are from:

In 2018, funding from Regenerative Medicine Minnesota allowed us to host 61 medical trainees from Mayo Clinic School of Medicine (n=57) and University of Minnesota Medical School – Twin Cities and Duluth (n=4). Among these students, 86% completed science-based undergraduate major and 14% completed non-science-based undergraduate major. The enrollment composed 81% MD program, 8% MD/PhD program and 7% PhD/Post-Doctorate program. Students from 2017-2018 were 56% male and 44% female.



**87%** medical school graduates encountered patient-specific questions about regenerative therapeutics (PRP/BMAC) and stem cell clinical trials

**92%** impacted how they envision practicing medicine

**61%** identified faculty mentor or network contact and **76%** intend to pursue regenerative sciences research

**38%** interested in additional degree (i.e. Master's or Ph.D.) in Regenerative Medicine

### University of Minnesota Stem Cell Institute – Meet the Experts: Speed Networking Event

Support from Regenerative Medicine Minnesota allowed us to host a networking event in collaboration with the UMN Stem Cell Institute. Medical students from Mayo Clinic School of Medicine and UMN Medical School were invited to participate in a speed networking session, where students and faculty engaged in round table discussions. Indeed, speed networking events have been widely successful in the business realm, and allows for participants to rapidly learn about new opportunities in addition to build interconnected relationships.



This event occurred in November 2018 and **engaged over 45 medical and graduate students**; UMN Stem Cell Institute faculty included Drs. Ann Parr (research in transplanting neural stem cells grown from a patient's own skin into the injured spinal cord), Bob Tranquillo (research in cardiovascular tissue engineering focuses creating transcatheter heart valves and vein valves, combining unique tubes of cell-produced matrix with stent technology), Brenda Ogle (research in the mechanisms of stem cell differentiation, especially in the context of the cardiovascular system), James Dutton (research utilizing developmental biology to inform our reprogramming strategies to generate differentiated cells for clinical application), Karen Echeveri (research in molecular and cellular level how an axolotl spinal cord can functionally repair after injury), Rita Perlingeiro (research in molecular mechanisms controlling lineage-specific differentiation of pluripotent stem cells), Troy Lund (research in use of blood and marrow transplantation (BMT) primarily for patients with leukemia, lymphoma, inherited metabolic disorders), Andrew Grande (research interest is translating stem cell therapies for stroke), Tim O'Brien (research in GMP-amenable method for generating brain organoids from human induced pluripotent stem cells) and Susan Keirstead (research in physiological characterization of stem cell-derived or reprogrammed cells using patch clamp and calcium imaging technologies). Student survey indicated that this event was valuable and guided research interests.

Medical student educational outreach included engaging Native American students in stem cell biology principles and simulated health care scenarios. Mayo Clinic School of Medicine and University of Minnesota medical students volunteered at teaching events such as, Minnesota Indian Education Association (November 2017), where they **engaged 50 - 60 high school students**. This activity was led by regenerative medicine and surgery selective teaching assistants (Michelle Hwang and Dr. Walter Franz).

### Medical Student Educational Outreach – Minnesota Native American Community

Medical student educational outreach included engaging Native American students in stem cell biology principles and simulated health care scenarios. Mayo Clinic School of Medicine and University of Minnesota medical students volunteered at teaching events such as, Minnesota Indian Education Association (November 2017), where they **engaged 50 - 60 high school students**. This activity was led by regenerative medicine and surgery selective teaching assistants (Michelle Hwang and Dr. Walter Franz).



Medical students also participated in the Science Fusion: American Indians in Science event (January 2018) and **taught 150 participants (age 4-10)** about stem cell science. This activity was also led by regenerative medicine and surgery selective teaching assistants (John Welby and Keely Redhage).

**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 151 medical students, 82 high school students, 8 visiting research fellows and 55 faculty members 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.

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. 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.



### Regenerative Medicine and Surgery Selective Program Scorecard

Metrics	2014	2015	2016	2017	2018
<b>1. To increase medical student knowledge of regenerative medicine and surgery</b>					
% change on pre-test/post -test learning objectives	N/A	N/A	45.6%	50.2%	TBD
% of students who felt they had acquired new regenerative medicine resources (goal 90%)	N/A	N/A	100%	100%	100%
# of students who felt they created a contact /network with a regenerative medicine faculty	N/A	N/A	59.1%	57%	56%
<b>2. To build interest in learning about regenerative solutions for clinical application</b>					
# of medical students enrolled	21	7	24	38	61
Daily/session attendance record (90% or above)	Yes	Yes	Yes	Yes	Yes
# of 4 <sup>th</sup> year students who return as TA	2	3	5	8	6
# of learning hours offered during selective dates	42	30	30	30	40

<b>3.To engage the enterprise in facilitating regenerative medicine “knowhow”</b>					
# of faculty lectures	18	20	18	27	32
# of different departments represented in faculty presentations	15	17	20	20	28
Enterprise involvement: Rochester, AZ, Florida, MCHS	2	3	3	3	3
<b>4.To build awareness of cutting-edge regenerative solutions</b>					
# of clinical trials presented	5	6	7	9	12
# of presentations involving a novel device/technology	7	12	12	12	12
# of non-didactic experiences (lab tours/simulation/etc.)	18	13	17	22	26
<b>5.Overall satisfaction of the program/learning experience</b>					
# of sessions with scores of 8-10 on satisfaction survey (10 highest)	N/A	N/A	14	18	22
% of students who would recommend the selective (goal 90%)	N/A	N/A	96%	100%	100%
% of students who felt they learned something that would positively impact the way they practice medicine (goal 90%)	N/A	N/A	91%	96%	92%

**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
  - Poster Presentation: Building the Next-Generation Workforce in Regenerative Medicine and Surgery: Results from the First 100 Medical Trainees (2014-2017). Mayo Clinic-Karolinska Institutet 23rd Annual Meeting.

**Responsible Spending:**

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

Funding renewal from Regenerative Medicine Minnesota allowed us to achieve 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 2018; these included UMN student housing and travel stipends, on-site symposium fees, and specific laboratory experiences. We also used the budget for a collaborative inter-campus “Meet the Experts” event between UMN and Mayo Clinic School of Medicine that facilitated an exchange of ideas between medical and graduate students. Furthermore, this award allowed medical student education outreach opportunities to Native American communities. A portion of our RMM funding was returned since our goal to host an undergraduate symposium in regenerative sciences was unable to be completed. Our funding proposal for 2018-2019 was successful and we plan to continue our efforts to expand this medical curriculum in addition to developing continuing medical education opportunities for practicing physicians in Minnesota.

Description	Final Cost
<b>Total Direct Cost</b>	\$32,580
<i>Symposium expenses, travel awards and cost to administer the pilot program</i>	
<b>Indirect Cost</b>	\$19,222
<b>TOTAL</b>	\$51,802
<b>REMAINING BALANCE (Returned to RMM)</b>	\$48,198***

\*\*\* Remaining balance reflects current balance and does not include pending or in process charges. A final and updated balance summary will be emailed to Regenerative Medicine Minnesota.