SMART Researchers Receive Intra-CREATE Grant for Personalised Medicine and Cell Therapy

Funds will support research on glaucoma through retinal biometrics, and neural cell implantation therapy for spinal cord injury

Singapore, 22 September 2020 - Researchers from Critical Analytics for Manufacturing Personalized-Medicine (CAMP), an interdisciplinary research group at Singapore-MIT Alliance for Research and Technology (SMART), MIT's research enterprise in Singapore, have been awarded Intra-CREATE grants from the National Research Foundation (NRF) Singapore to help support research on retinal biometrics for glaucoma progression and neural cell implantation therapy for spinal cord injuries. The grants are part of the NRF's initiative to bring together researchers from Campus for Research Excellence And Technological Enterprise (CREATE) partner institutions, in order to achieve greater impact from collaborative research efforts.

SMART CAMP was formed in 2019 to focus on ways to produce living cells as medicine delivered to humans to treat a range of illnesses and medical conditions, including tissue degenerative diseases, cancer, and autoimmune disorders.

"Singapore's well-established biopharmaceutical ecosystem brings with it a thriving research ecosystem that is supported by skilled talents and strong manufacturing capabilities. We are excited to collaborate with our partners in Singapore, bringing together an interdisciplinary group of experts from MIT and Singapore, for new research areas at SMART. In addition to our existing research on our three flagship projects, we hope to develop breakthroughs in manufacturing other cell therapy platforms that will enable better medical treatments and outcomes for society," said Krystyn Van Vliet, co-lead Principal Investigator at SMART CAMP, and Professor of Materials Science and Engineering at MIT.

Understanding Glaucoma Progression for Better Targeted Treatments

Hosted by SMART CAMP, the first research project, *Retinal Analytics via Machine learning aiding Physics* (RAMP), brings together an interdisciplinary group of ophthalmologists, data scientists, and optical scientists from SMART, Singapore Eye Research Institute (SERI), Agency for Science, Technology and Research (A*STAR), Duke-NUS Medical School, Massachusetts Institute of Technology (MIT), and National University of Singapore (NUS). The team will seek to establish first principles-founded and statistically confident models of glaucoma progression in patients. Through retinal biomechanics the models will enable rapid and reliable forecast of the rate and trajectory of glaucoma progression, leading to better targeted treatments.

Glaucoma, an eye condition often caused by stress-induced damage overtime at the optic nerve head, accounts for 5.1 million of the estimated 38 million blind in the world and 40% of blindness in Singapore. Currently, health practitioners face challenges forecasting glaucoma progression and its treatment strategies due to the lack of research and technology that accurately establish the relationship between its properties, such as the elasticity of the retina and optic nerve heads, blood flow, intraocular pressure and, ultimately, damage to the optic nerve head.

The research is co-led by George Barbastathis, Principal Investigator at SMART CAMP and Professor of Mechanical Engineering at MIT, and Aung Tin, Executive Director at SERI and Professor at the Department of Ophthalmology at NUS. The team includes CAMP Principal Investigators Nicholas Fang, also Professor of Mechanical Engineering at MIT, Lisa Tucker-Kellogg, Assistant Professor with the Cancer and Stem Biology programme at Duke-NUS and Hanry Yu, Professor of Physiology with the Yong Loo Lin School of Medicine, NUS and CAMP's co-Lead Principal Investigator.

"We look forward to leveraging the ideas fostered in SMART CAMP to build data analytics and optical imaging capabilities for this pressing medical challenge of glaucoma prediction," said Professor Barbastathis.

Cell Transplantation to Treat Irreparable Spinal Cord Injury

Engineering Scaffold-Mediated Neural Cell Therapy for Spinal Cord Injury Treatment (ScaNCellS), the second research project gathers an interdisciplinary group of engineers, cell biologists, and clinician scientists from SMART, Nanyang Technological University (NTU), NUS, IMCB A*STAR, A*STAR, French National Centre for Scientific Research (CNRS), University of Cambridge, and MIT. The team will seek to design a combined scaffold and neural cell implantation therapy for spinal cord injury treatment that is safe, efficacious and reproducible; paving the way forward for similar neural cell therapies for other neurological disorders. The project, an intersection of engineering and health, will achieve its goals through an enhanced biological understanding of the regeneration process of nerve tissue and optimised engineering methods to prepare cells and biomaterials for treatment.

Spinal cord injury (SCI), affecting between 250,000 and 500,000 people yearly, is expected to incur higher societal costs as compared to other common conditions such as dementia, multiple sclerosis, and cerebral palsy. SCI can lead to temporary or permanent changes in spinal cord function, including numbness or paralysis. Currently, even with the best possible treatment, the injury generally results in some incurable impairment.

The research is co-led by Chew Sing Yian, Principal Investigator at SMART CAMP and Associate Professor of the School of Chemical and Biomedical Engineering and Lee Kong Chian School of Medicine at NTU, and Laurent David, Professor at University of Lyon (France) and leader of the Polymers for Life Sciences group at CNRS Polymer Engineering Laboratory. The team includes CAMP Principal Investigators Ai Ye from Singapore University of Technology and Design, Jongyoon Han and Zhao Xuanhe both Professors at MIT, as well as Shi-Yan Ng and Jonathan Loh from Institute of Molecular and Cell Biology, A*STAR.

Professor Chew said, "Our earlier SMART and NTU scientific collaborations on progenitor cells in the central nervous system are now being extended to cell therapy translation. This helps us address SCI in a new way, and connect to the methods of quality analysis for cells developed in SMART CAMP."

"Cell therapy, one of the fastest-growing areas of research, will provide patients with access to more options that will prevent and treat illnesses, some of which are currently incurable. Glaucoma and spinal cord injuries affect many. Our research will seek to plug current gaps

and deliver valuable impact to cell therapy research and medical treatments for both conditions. With a good foundation to work on, we will be able to pave the way for future exciting research for further breakthroughs that will benefit the healthcare industry and society," said Hanry Yu, co-lead Principal Investigator at SMART CAMP, Professor of Physiology with the Yong Loo Lin School of Medicine, NUS, and Group Leader of the Institute of Bioengineering and Nanotechnology at A*STAR.

The grants for both projects will commence on 1st October, with RAMP expected to run until 30th September 2022 and ScaNCellS expected to run until 30th September 2023.

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About Singapore-MIT Alliance for Research and Technology (SMART) [新加坡-麻省理工学院科研中心]

Singapore-MIT Alliance for Research and Technology (SMART) is MIT's Research Enterprise in Singapore, established by the Massachusetts Institute of Technology (MIT) in partnership with the National Research Foundation of Singapore (NRF) since 2007. SMART is the first entity in the Campus for Research Excellence and Technological Enterprise (CREATE) developed by NRF. SMART serves as an intellectual and innovation hub for research interactions between MIT and Singapore. Cutting-edge research projects in areas of interest to both Singapore and MIT are undertaken at SMART. SMART currently comprises an Innovation Centre and five Interdisciplinary Research Groups (IRGs): Antimicrobial Resistance (AMR), Critical Analytics for Manufacturing Personalized-Medicine (CAMP), Disruptive & Sustainable Technologies for Agricultural Precision (DiSTAP), Future Urban Mobility (FM) and Low Energy Electronic Systems (LEES).

SMART research is funded by the National Research Foundation Singapore under the CREATE programme.

For more information, please visit - http://smart.mit.edu

About Critical Analytics for Manufacturing Personalized-Medicine (CAMP) Interdisciplinary Research Group (IRG)

CAMP is a SMART interdisciplinary research group launched in June 2019. It focuses on better ways to produce living cells as medicine, or cellular therapies, to provide more patients access to promising and approved therapies. The investigators at CAMP address two key bottlenecks facing the production of a range of potential cell therapies: critical quality attributes (CQA) and process analytic technologies (PAT). Leveraging deep collaborations within Singapore and MIT in the United States, CAMP invents and demonstrates CQA/PAT capabilities from stem to immune cells. Its work addresses ailments ranging from cancer to tissue degeneration, targeting adherent and suspended cells, with and without genetic engineering.

CAMP is the R&D core of a comprehensive national effort on cell therapy manufacturing in Singapore.

For more information, please visit: https://camp.smart.mit.edu/