HOPEWELL
M.I.N.D. PRIZE

Hopewell M.I.N.D. Prize
2022 Finalists

Dr Garnette Sutherland

Title of Project: *"CellARM: A MicroRobotic System for Data-driven Precision Surgery"*

Dr. Sutherland received his undergraduate education in both science and medicine at the University of Manitoba, Winnipeg, Manitoba (1974 and 1978 respectively). His post-graduate education was completed in 1984 at the University of Western Ontario, London, Ontario. That year, he was appointed Assistant Professor of Surgery (Neurosurgery) and Pharmacology at the University of Manitoba and promoted to Associate Professor at the same university in 1988. In 1993, he accepted the position of Professor and Head of Neurosurgery, Department of Clinical Neurosciences, University of Calgary, Calgary, Alberta and was Head until 2003.

Dr. Sutherland has made a number of contributions to science and medicine, as reflected by 166 abstracts, 136 peer-reviewed publications, 16 monographs or book chapters, and five patents. His major research focus has been the application of MR techniques to the study of neurological diseases. He has been able to attract millions of dollars through a number of local and national grant competitions and has received a number of awards over the years, including the Manning Award of Distinction for the development of a Intraoperative MR system based on a movable 1.5 Tesla magnet, and the Federal Partners in Technology Transfer in 2007. Dr. Sutherland is also the Founding Director of the Seaman Family MR Research Centre, and has received multiple international invitations and has made presentations in Australia, Asia, Europe, Hawaii, New Zealand, and North America. In 2012, Dr. Sutherland was awarded The Order of Canada award for his outstanding contribution to neurosurgery.

Dr. Garnette Sutherland completed his residency in Neurosurgery at the University of Western Ontario. His first appointment was at the University of Manitoba, in both the Departments of Surgery and Pharmacology. There, in addition to his clinical work, he established an experimental laboratory, one of the first of its kind, for the study of neurological disease using MR imaging and spectroscopy. In 1993, Sutherland was appointed the head of Division of Neurosurgery at the University of Calgary. In collaboration with NRC-Canada, he developed the world's first intraoperative MRI system based on a moveable l.5T magnet. With MDA, Sutherland also developed neuroArm, an image-guided MR-compatible robotic system. In 2004, Dr. Sutherland received the Manning Award of Distinction for this work, in 2007, the Alberta Science and Technology Leadership Foundation award and in 2008, the City of Calgary Signature Award. He was awarded the Queen Elizabeth Diamond Jubilee medal 2012 and in 2013, the American Astronautical Society and NASA for the earth applications of space technology. He received the CIHR-CMAJ Top Achievements in Health Research Award in 2013 for his scientific accomplishments. He has given over 260 national and international lectures and published 190 manuscripts, 15 patents and 29 book

excerpts. In 2011, Sutherland was appointed to the Order of Canada for his lifetime achievement in healthcare innovation and in 2014, was inducted into the Space Technology Hall of Fame for neuroArm. In July 2015, Dr. Sutherland was awarded with the NASA Highest Technology Achievement Medal for his work on neuroArm.
(University Profile - https://charbonneau.ucalgary.ca/our-members/full-members/dr-sutherland-garnette)

Summary of Proposed Innovation:
CellARM, a robotic extension of a surgeon, providing a greater accuracy and precision, and access to data on procedural best practices. CellARM is a multi-purpose dextrous arm designed for robot-assisted brain/spine surgery, capable of manipulating human tissue at a microscopic level not currently possible for a human surgeon alone. CellARM is equipped with an endoscopic camera and sensors that supply extensive data on all the arm's movements during a procedure. CellARM will allow surgeons not only to interrogate the genetic basis of disease, but also to see what they cannot see, feel what they cannot feel and hear what they cannot hear. Breaking new ground in medical technology, CellARM incorporates patient biology and disease paradigms in real time, transmitting characteristic signals and data to the surgeon at a workstation for recognition and guidance. The data from these sensors is organized in the CellARM's memory, making it more of an expert than a human could ever be. And through machine learning CellARM learns from each of those surgeries, so the next one will be even more accurate and more effective.

Because CellARM gathers data and learns from each surgery it is involved, it offers practitioners a wealth of constantly evolving knowledge on best practices. It also offers instant feedback, telling surgeons when they are pressing too hard or too soft. It records each movement, building a database to inform surgeons as well as assist them become better each time. Designed with open-learning in mind, CellARM will evolve along with developments in cellular-level medicine, such as molecular tissue characterization and nanoscale analytics. When surgeons view CellARM's cloud-based databank on their smartphones, they will connect to a global network of peers and information. In this way, CellARM can propel the field toward standardized care.

This research, on the cusp of Project neuroArm's established track record of historical proportions, is an ideal conduit to a future of continued innovation and sustainability.