Professor Lim Chwee Teck:
Fight the good fight

Prof Lim Chwee Teck is an unlikely warrior in the on-going fight against diseases such as malaria and cancer, but thanks to his efforts as a Faculty Fellow at SMART, those scourges will be defeated even more quickly.

Prof Lim heads the Nano Biomechanics Lab at the National University of Singapore (NUS), and it is through this lab that he and his students interact with two IRGS at SMART on cancer and malaria research: Biosym and Infectious Diseases.

"Our focus is in applying biomechanics principles to better understand the pathophysiology of human diseases, which fits well with several of the projects that MIT faculty is pursuing at SMART. It's only natural that we'd start to work together on this vital area of research," he explained.
These accomplishments in biotechnology belie a startling revelation, namely that Prof Lim's educational background is in mechanical engineering! He holds a Bachelor of Engineering (First Class Honours) from the National University of Singapore and a PhD in Engineering from the University of Cambridge (UK). Ever modest, he explained, "I first became interested in biomechanics about a decade ago. It took about the first five years of basic research and much learning to get myself up to speed, and the last five years in applying the knowledge gained in developing biomechanics based microdevices that will eventually be used in a clinical setting."

Radical moves
In particular, Prof Lim's interest is in the "mechnopathology" of diseased cells. "What I want to do is understand the structural and biomechanical property changes of diseased cells. I want to know how disease pathology can arise from such changes. Once we obtain such understanding, we can proceed to the next few steps which can involve early detection, prevention, and ultimately, eradication of these diseases."

In order to conduct this study, Prof Lim's lab has state-of-the-art tools that to non-specialists sound like inventions from science fiction. "We use optical tweezers to manipulate individual blood cells to understand the pathophysiology of a disease like malaria." For those not in the know, optical tweezers are lasers that can trap minuscule transparent silica beads that have been attached to the sides of a blood cell. Harnessing the force that the light waves make as they pass through the silica bead, Prof Lim's team is able to pull or squeeze on the cell to test its elasticity. "Working with Dr Ming Dao and Prof Jianshu Cao rom the Infectious Disease IRG, we know that cells infected with malaria lose their elasticity. With the optical tweezers, we can get a quantitative measurement of the exact amount of elasticity that has decreased as the disease progresses."

Or take "microfluidic devices" as an example: Prof Lim's team pushes cells through a 2x2 micron microchannel. Healthy cells are elastic enough to squeeze through and recover their original shape after passing through the channel, while malarial infected red blood cells have lost too much elasticity and create a cellular log jam at the entrance. "The implications for how diseased blood affects our bodies is obvious," Prof Lim explained, "If the cells can't make it through or clog these capillaries, then some of the organs in our body will be starved of oxygen, and that has very immediate effects."

Microfluidics also play a part in Prof Lim's work on cancer cell detection and capture (yes, capture), with the Biosym IRG at SMART. "We know that after a tumour takes shape and when it becomes maglinant, cancer cells may leave the tumor, squeeze into andtravel in the bloodstream before they get lodged into other parts of the body and start to form secondary tumours (a process known as metastasis).

"These travelling cancer cells are much larger than blood cells, so we are able to create microdevices that can capture these cancer cells. This is especially important because these captured cells are viable—that is, they are still alive—which means that we can perform further study to understand how they migrate and try to discover ways to disrupt their invasiveness. Most of the current systems in use to detect or capture cancer cells actually destroy or "violate" these cells when they're captured." By more accurately and gently sieving out the cancer cells from the bloodstream, Prof Lim's microfluidic systems can also possibly help in the early detection of cancer.

Real impact

"Working with my colleagues at SMART has been very beneficial both to my research as well as for my graduate students and post-doc fellows," says Prof Lim. "Many of the students might not otherwise get a chance to work so closely with another research group from another country. NUS has been striving to become more interdisciplinary in its approach to research, and the activities at SMART are a valuable way for students and staff to learn how to handle an ever changing research environment."

"Working with SMART has been very beneficial in advancing some of our multidisciplinary research on human diseases. This will in turn not only help us to better understand these diseases but also lead us to develop devices that have the potential to save a great many lives and relieve untold suffering. There's really no substitute for face to face collaboration like the kind that SMART allows us to have across disciplines and hopefully one outcome of this will be a serious blow to front-line diseases such as malaria and cancer."

A prolific author and winner of numerous research awards, Prof Lim is a Professor of Bioengneering and Mechanical Engineering and a Principal Investigator at the Mechanobiology Institute at NUS. He is also an entrepreneur who has co-founded several companies to support and market technologies such as a cancer microfludic biochips that his lab has created. This biochip is already being tested in a hospital setting both locally and overseas.

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