IMCRC – Supporting medical innovation

From predicting the risk of heart problems, to building blood vessels outside of the body, to tackling bacterial biofilms, the Innovative Manufacturing Cooperative Research Centre (IMCRC) is involved in a host of projects in support of groundbreaking medical innovations.

A hand-held device to predict heart failure based on saliva could help millions of potential victims take preventative steps to avoid their fate. Nano-sensors on the tip of the diagnostic stick measure heart disease biomarkers from saliva to accurately predict the risk of heart disease, failure or heart attack, then warn users via a simple app. Now a multi-partner deal has just been signed to bring the life-saving technology to market by 2021.

The collaboration is being led by an Australian start-up based in Melbourne called ESN Cleer, with RMIT University and the IMCRC now researching and developing the device for pilot manufacture. ESN Cleer CEO Leopoldt de Bruin says the collaboration represents some of the best minds in medical device innovation, design and manufacture.

"We're really pleased to be able to bring these strands together in addressing such a major global health challenge," De Bruin said. "Of the 400 million people who suffer from cardiovascular disease globally, only 16% of cases are due to genetic traits. This underlines how much room there is to improve on screening and prevention, which is where this device could have such an impact."

Cardiovascular disease currently accounts for nearly one-third of all global disease deaths each year.

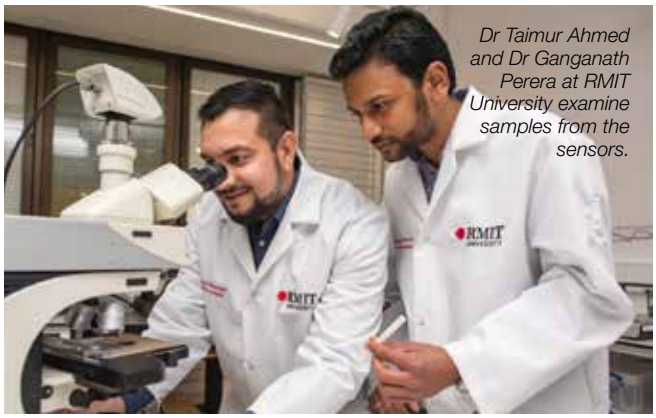
Research Co-Director of RMIT's Functional Materials and Microsystems Research Group, Professor Sharath Sriram, said ESN Cleer's device is the first portable heart disease test with such high levels of accuracy. The sensing technology, developed at RMIT's cutting-edge Micro Nano Research Facility, was validated in the lab to measure biomarker concentrations a thousand times more precisely than levels in human body fluids.

"This marks a big step forward in technology for screening," Sriram says. "Currently, blood tests are conducted after a heart failure episode. Such reactive testing is too late, leaving people with debilitating illness or leading to deaths. Prevention is always better than cure, which is where this technology comes in, adding accurate prediction to the mix."

The IMCRC funding, which matches contributions from ESN Cleer, is enabling a $3.5m project investment into addressing the challenge of manufacturing and large-scale production of these diagnostic swabs. "Utilising advanced materials and adopting high-precision, automated manufacturing processes will allow the swabs to be high value and at a competitive cost," explains David Chuter, CEO and Managing Director at the IMCRC.

Being manufactured in Australia, the swabs will also adhere to medical regulatory approvals. RMIT healthcare design expert

ESN Cleer's device is equipped with nano-sensors on the tip that measure biomarkers in saliva to accurately predict the risk of heart disease, failure or heart attack.



Dr Taimur Ahmed and Dr Ganganath Perera at RMIT University examine samples from the sensors.

Dr Leah Heiss is working with the team, bringing insights into designing the device to be as user-friendly as possible.

"The aesthetics, tactility and usability of the product has to be balanced with manufacturability and cost," Heiss says. "By bringing users into the design process early on, we are considering the human experience in parallel with the operation of the technology."

Incentivised feedback through the system will encourage users to take preventative actions, while machine learning algorithms used to assess results will further improve system accuracy over time. It is envisaged that the device will also be used to predict cancer risk down the track

Building blood vessel implants

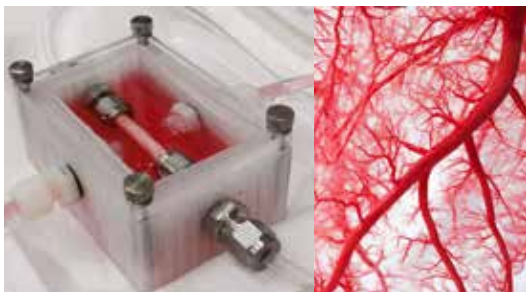
A project working on building blood vessels outside of the body has attracted further industry attention, with the IMCRC joining Dr Steven Wise and Codex Research in the research collaboration. Dr Steven Wise and his team in the Faculty of Medicine and Health at the University of Sydney (UoS) have partnered with the IMCRC, after securing backing from Codex Research earlier this year.

The IMCRC has committed $851,000 of Commonwealth funding to the research, which is projected to be underway until 2022. The collaboration will be the second research partnership between the UoS and Codex.

Dr Wise's work aims to improve the treatment of heart disease by engineering a physiologically relevant blood vessel implant used in bypass surgery. To reduce the failure rate compared with traditional plastic counterparts, Dr Wise and his team employ a range of synthetic and natural materials with the aim of developing new synthetic graft materials which combine tailored mechanical properties with improved biocompatibility. Current lab-based methods to assess these new materials have significant limitations, and better mimicry of human systems in a laboratory environment would greatly benefit this research area.

As well as funding, IMCRC has provided substantial support and guidance in helping to focus on business and manufacturing requirements, and has helped to crystalise a sophisticated business model for the project. David Chuter says the project exemplifies the exciting times for organisations working in emerging fields such as biotechnology like Codex.

"Digital and advanced manufacturing technologies are creating new opportunities for Australia's biotechnology sector, collecting, analysing and providing information that speeds up the discovery and engineering process of new products that have real-life impact,"



A vascular graft in bioreactor.

David Chuter and Dr Matthew Young from IMCRC (third and fourth from left), along with Dr Jessica Farrell, John Stewart, Dr T Das and Dr Jim Manos.

says Chuter. "Investing in a project that lays the manufacturing foundation to develop highly tailored products that mimic the human vascular system to then be able to create life-changing products such as new vascular implants is very rewarding."

Novel solutions for biofilm infections

In early August the first annual review meeting was conducted for the Novel Solutions for the Biofilm Infections research project. This is a collaborative research project between the IMCRC, UoS and Whiteley Corporation, with an investment of over $4m over four years.

"This work will be of major medical significance worldwide" says Dr Greg Whiteley, Executive Chairman at Whiteley Corporation. "Bacterial biofilms cause both human disease and death, and these microbes are also responsible for contamination in industrial and institutional settings."

Since the project commenced in mid-2018, great progress has been made in both research and model development.

"A paper entitled *'Conditions under which glutathione disrupts the biofilms and improves antibiotic efficacy of both ESKAPE and non-ESKAPE species'* was recently published in the high impact journal Frontiers in Microbiology," says Dr Jim Manos of UoS. "The paper shows that the antioxidant glutathione (GSH) not only disrupts biofilm in a wide range of bacterial species, including Pseudomonas aeruginosa, but also enhances the effectiveness of antibiotics against these bacteria."

A second area where much progress has been made is in the development of a range of models to better represent the various areas in which biofilms effect the human body. The project is on track to deliver its key milestones and inform the manufacturing processes and technologies required to commercialise, and has received a green light from IMCRC.

Regarding the research progress and positive impact of industry and research organisations working together, David Chuter says: "It is particularly rewarding to see a project that is on track to deliver novel solutions which promise an optimistic future for controlling and removing biofilms formation in different industry applications and thus reduce the risk of infections."

Dr Whiteley adds: "The end goal of this project is to bring products to market which effectively disrupt the formation of biofilm and eradicate underlying bacteria in range of infections." **AMT**

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