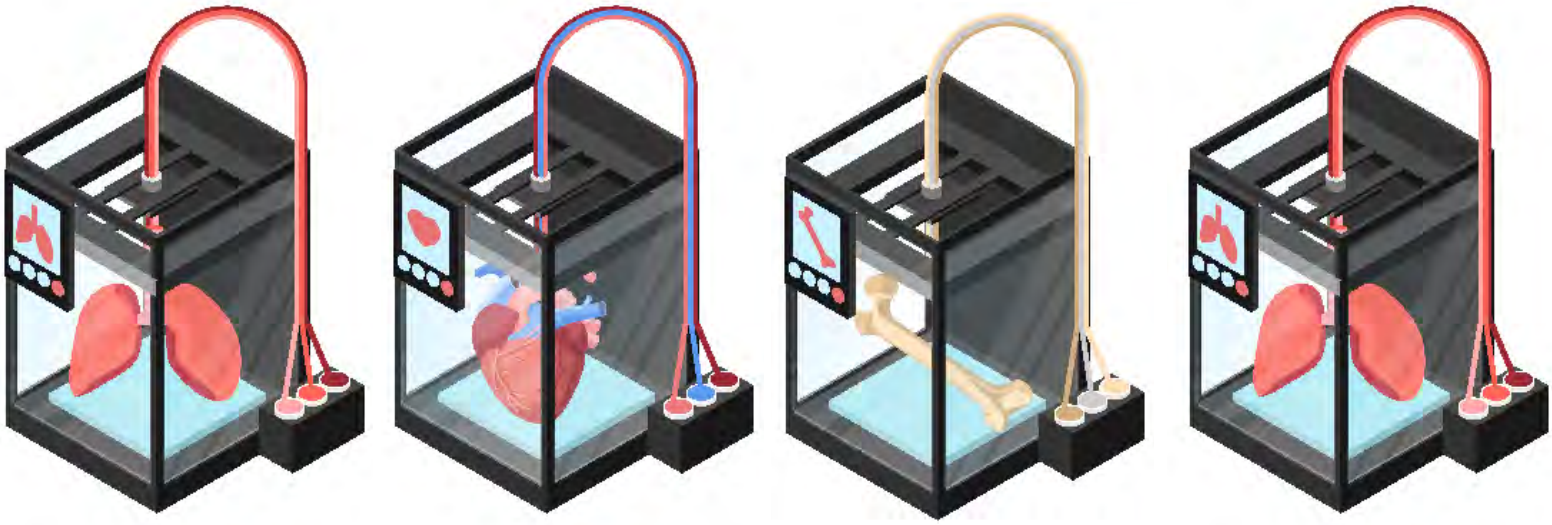
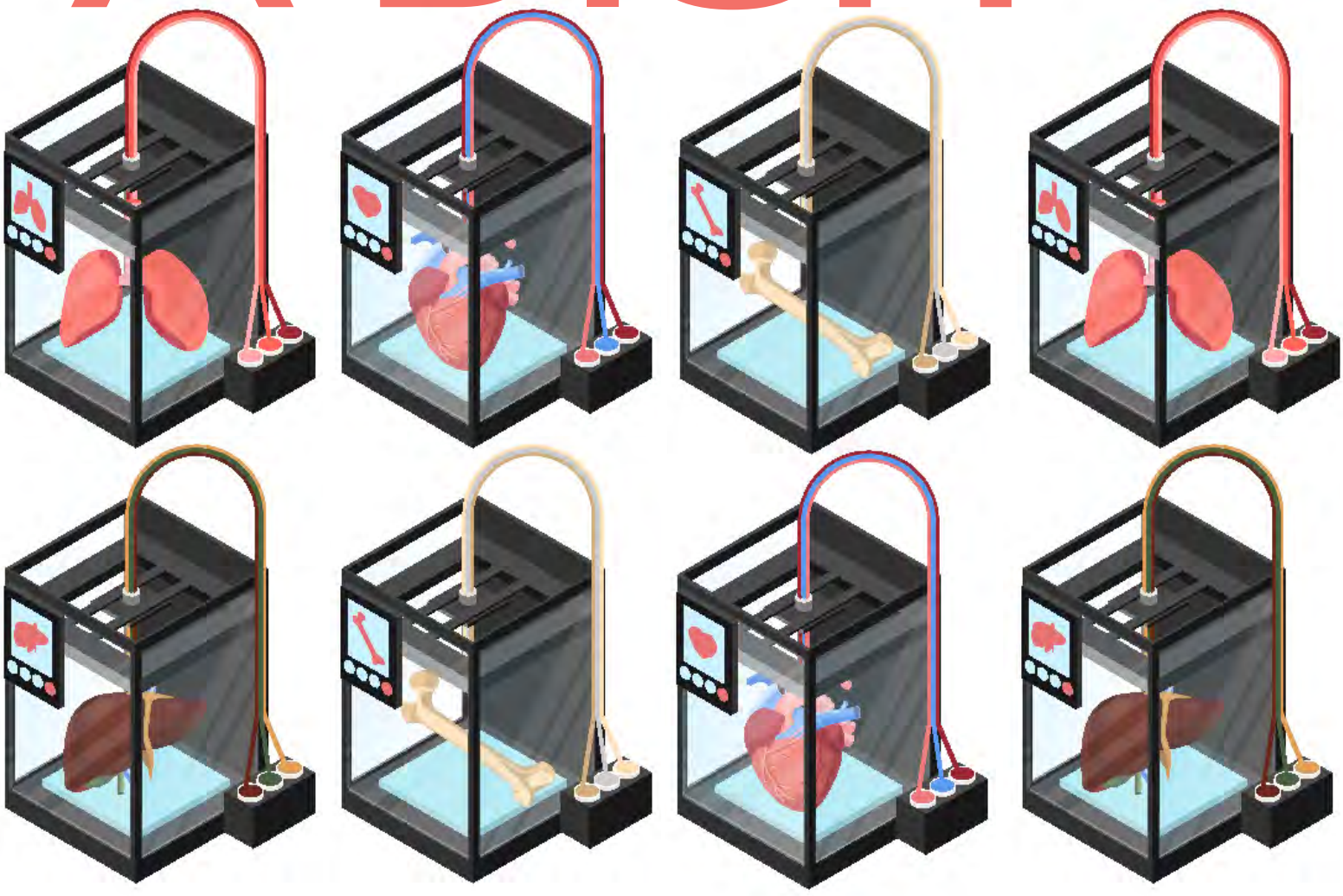


LIVER IN A DISH



The 1982 classic film 'Blade runner', set in LA in the year 2019, brought to life a world in which artificial humans could be engineered in a lab. Now, the real world is catching up with Ridley Scott's imagination and we are working on the potential of patients growing their own live using their own cells.

The O'Brien Institute Department at St Vincent's Institute (SVI) leads the way in reconstructive microsurgery and tissue engineering, with the aim of tackling issues such as lymphoedema, cardiac dysfunction and liver disease.

"Since its genesis 60 years ago, SVI has been at the frontier of research innovation", says Director, Professor Tom Kay. "We study common diseases that affect many Australians, and our researchers bring a diverse range of techniques and experience to the table. SVI's work spans the research spectrum, from fundamental research, right through to clinical studies, with improved health of the patient always at the forefront of our work."

ORGANOIDS TO GROW LIVER TISSUE

In 2016, Associate Professor Geraldine Mitchell and her long-time colleague Professor Wayne Morrison, were awarded an NHMRC Project Grant to fund the development of what they call a 'liver in a dish.' The ultimate aim of their work is to grow an 'organoid' (a miniature, simplified version of an organ) derived from a patient's own cells, to be used as a source of tissue for liver transplantation.

Geraldine says that liver disease is more common than is generally recognised in Australia. It is associated with common conditions such as obesity, diabetes, viral hepatitis, excessive alcohol intake and cancer.

> ***"The only current treatment for advanced liver disease is transplantation and, because there are not enough organs to meet demand, many patients die before they can get a transplant," says Geraldine.***

Geraldine's research involves a multi-disciplinary team, including scientists and surgeons, whose focus is on using human cells to 'grow' a liver that could be up-scaled in the future to be used for transplantation, or as a platform on which to test drugs to treat the disease.

Geraldine explains that without the involvement of surgeons at St Vincent's Hospital, and in particular, her PhD student, Surgical Fellow, Dr Kiryu Yap, the project would not be viable.

"Kiryu is often called, both in and out of hours, to collect liver tissue from patients having surgery who have agreed to us using very small segments of their liver for our experiments. For this project, access to human cells is paramount."

With the consent of Hepatobiliary Unit patients at St Vincent's Hospital Melbourne, Dr Yap attends surgeries to remove cancer in the liver and harvests a small sample of healthy tissue.

Kiryu says that one of the major hurdles is the need for cells in the organoid to get enough oxygen. The team are approaching this problem by engineering a vascular system within organoids, derived from human endothelial cells and support cells that form blood vessels and facilitate liver development.

Other components include a porous scaffold, provided by PolyNovo Ltd. Melbourne, that provides a physical support upon which the cells can grow and a special gel, which provides other factors that promote the cells' survival.

FROM DISH TO TRANSPLANTATION

Ultimately, the team intend to use stem cells from a person with liver disease to grow liver tissue for transplantation. Geraldine says that this is the most clinically feasible method to generate the millions of liver cells that would be required for personalised organoid generation. "Organoids represent the most advanced approach to creating structures with the complex architecture and diverse functions of the liver, and may allow relevant drug testing and disease modelling in addition to their use in liver tissue replacement,"says Geraldine.

> ***"This research, using human tissue, wasn't happening 10 years ago, but technological advancements in vascular biology and bioengineering mean that it is now moving in leaps and bounds."***

The promise of genetically identical replacement body parts may not just be the stuff of science fictions and the way is being paved by Geraldine and her team.

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