Preclinical Modelling

Accelerating access to safer, more effective and cost-efficient medical solutions

Improving patient outcomes

Preclinical modelling gives researchers and clinicians the power to predict how treatments will perform before they reach people. More effective and accurate models allow clinicians to test proposed therapies, like biomedical devices or drugs, so they can find the right treatment at the right time for the right patient. Researchers can optimise new drugs and devices using computer simulations or 3D tissue or organ models that are safer, faster, more accurate, less costly and reduce the need for animal testing. Better models ensure only the most promising treatments advance into human clinical trials – saving time and resources while improving patient outcomes.

Transforming research into real-world solutions

The QUT Centre for Biomedical Technologies is developing a variety of next-generation preclinical models to improve patient outcomes. Our approach includes:

- computer simulations to improve cancer treatments and radiation targeting
- AI-powered models that predict disease progression, reduce complications and optimise therapies
- 3D tissue and organ models for testing drugs and regenerative solutions for bone trauma
- patient-specific simulations to guide surgery and design custom implants
- real-world refinement of models through surgical validation and implant testing
- computer and "patient-on-a-bench" models to investigate artificial heart performance under a range of physiological conditions
- fundamental research into biomechanics, cellular and tissue biology to inform accurate models.

#1 in Australia for biomedical engineering

700,000+ medical implants enhanced by our preclinical models

25+ Chief Investigators in modelling and evaluation

We discover, develop and deliver the next frontier of biomedical technologies, including organs-on-a-chip, for better patient treatment and quality of life.

QUT Centre for Biomedical Technologies

Case Studies

Organs-on-chip for next-generation drug development

Professor Yi-Chin Toh is a leader in organ-on-a-chip technology, an alternative model for testing therapeutic drugs that can be more accurate, affordable and ethical than traditional methods. Therapeutic drugs and many diseases affect the body as a system, so testing drugs on individual cell cultures fails to capture critical organ interactions that influence drug response. Researchers often resort to animal testing to overcome this problem, but this method is expensive, ethically fraught and doesn't always reflect how human systems behave. Professor Toh has engineered modular microenvironments that mimic organ function, and can be connected to test drug response as a systemic whole. This platform has accurately and more rapidly predicted chemotherapy responses in cancer patients, and identified whether drugs will cause life-threatening skin reactions due to interactions between the liver, immune system and skin.

3D modelling of hip and bone fractures

Dr Beat Schmutz has applied his expertise in 3D modelling to improve implants used to treat hip fractures. One of the treatment options is a nail that holds the fractured bone together, allowing it to heal. This method is highly effective, but complications can arise when the nail doesn't fit a patient's anatomy. However, designing a nail that works for a global population with a range of bone sizes, shapes and strength can be challenging. Dr Schmutz developed a custom tool that informed the development of two nails that better fit the anatomy of a diverse patient population. The TFN-Advanced Proximal Femur Nailing System has been in use since 2015, and the Femoral Recon Nail since 2018, with the former selling over 700,000 units in its first seven years on the market.

Bioengineering solutions for bone metastatic cancers

Dr Jacqui McGovern and Associate Professor Nathalie Bock are providing new insights into tailored treatment options for cancers that have spread to the bone, particularly osteosarcoma and prostate cancer, respectively. Oncology drug candidates have the highest rate of failure in clinical trials because of the complexity of the disease and its interactions with surrounding cells. By creating 3D tissue models that closely mimic the bone microenvironment and its surroundings, and seeding these with tumour cells, the researchers can more accurately assess drug candidates, and advise clinicians on the most effective treatments for individual patients. Dr McGovern is also investigating ways to deliver chemo directly to the bone to minimise side effects, while Professor Bock has demonstrated that a routine treatment for prostate cancer can fuel tumour progression in the bone.

Understanding soft tissues in health and disease

Professor Cameron Brown is developing advanced computational models that help us better understand how soft tissues – such as the cartilage in joints – function when healthy, and the physical processes that cause them to break down in disease. The research, in collaboration with the University of Oxford, shows how different treatments could interrupt the progression of diseases such as arthritis, paving the way for better therapies and personalised patient care. The models are powered by cutting-edge imaging techniques that provide highly detailed information on tissue structure, allowing the researchers to simulate how these tissues behave and their interactions with the collagen networks that provide support and flexibility. Professor Brown is Director of the Medical Engineering Research Facility, which plays a key role in development and testing of new medical devices, and training clinicians in their use.

Contact us

Centre for Biomedical Technologies

biomedtech@qut.edu.au

Find out more
research.qut.edu.au/cbt