

Chinese University

BULLETIN

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Envisioning a
healthier future



Chinese University
BULLETIN

- 02** The brave new world of biomedicine
- 10** As if it were newly born
Regenerative medicine experts offer hopes of recovery and wholeness
- 16** Where the MagIC Happens
Targeting the trillions of microorganisms in the human gut may yield treatments for conditions as diverse as colorectal cancer, autism, eczema, obesity, depression and long COVID
- 22** The DNA of Innovation
Deciphering genetic clues for novel diagnostics, from safeguarding foetal health to screening for cancers
- 28** Innovating for impact
- 30** Appointments

Contents



02



10

16



22

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The brave new world of biomedicine

In light of ageing populations and the sporadic emergence of global infectious disease in different parts of the world, biomedical research has become quintessential for safeguarding public health.

Hong Kong has significant strength in driving biomedical innovations. The city has two outstanding medical schools ranked among the world's top 40 by QS World University Rankings and numerous internationally renowned scientists. The Hong Kong government has launched a series of initiatives relating to translational biomedicine. Prime examples include the healthcare cluster of its flagship InnoHK initiative and the Hong Kong Genome Project.

Opportunities abound for commercialisation of biomedical inventions, such as the availability of funding and space for start-ups offered by the Hong Kong Science Park and the Hong Kong Stock

Exchange's new initiative for listing pre-revenue biotechnology companies.

With funding from the Hong Kong government to the tune of HK\$10 billion, InnoHK is part of the administration's commitment to transform the city into an innovation and technology (I&T) powerhouse and diversify beyond its core competitiveness as an international financial centre and a gateway for business in China and Asia.

InnoHK serves as a platform to promote cross-disciplinary and cross-jurisdictional collaboration for translating research outcomes. It is hoped that this synergy will benefit society and the world substantially. The InnoHK Centres involve seven local universities and research institutions as well as over 30 collaborators from 11 economies, pooling around 2,000 local and global researchers.



The innovation exhibition at CUHK Innovation Day 2022 displays scientific research of CUHK InnoHK Centres

CONTRIBUTION TO HONG KONG'S INNOVATION AGENDA

Since October 2021, CUHK has established six InnoHK Centres covering health, biomedicine, robotics and artificial intelligence. Located at the Science Park and just a stone's throw away from CUHK's Shatin Campus, the Centres apply CUHK's world-class research discoveries to generate translational impact on a local, national and global scale.

Health@InnoHK and AIR@InnoHK (artificial intelligence and robotics) are the first two research clusters established under the initiative. Health@InnoHK aspires to be a holistic research hub on human health, from traditional to pioneering medicine, biological study to bioinformatics and novel drugs and medical devices. AIR@InnoHK intends to enhance efficiency

in finance, health care, construction, logistics and advanced manufacturing.

The InnoHK initiative resonates with CUHK's strategic commitment to accelerating innovative scientific research and the research commercialisation continuum. Combining the University's expertise and leveraging partners from prestigious global universities including Oxford, Cambridge, Karolinska Institutet, UC Berkeley, ETH Zurich, Massachusetts Institute of Technology, CUHK's InnoHK Centres will position Hong Kong as a global powerhouse of innovation connecting the world with the rapidly emerging research and innovation ecosystem of the Guangdong-Hong Kong-Macau Greater Bay Area (GBA).

Health@InnoHK

- Center for Neuromusculoskeletal Restorative Medicine
- Centre for Novostics
- Microbiota I-Center



AIR@InnoHK

- Centre for Perceptual and Interactive Intelligence
- Hong Kong Centre for Logistics Robotics
- Multi-Scale Medical Robotics Centre



Professor Rocky S. Tuan
Vice-Chancellor and President



These six Centres capture the essence of CUHK's excellence and reflect two key areas of focus under our new Strategic Plan—Innovative Biomedicine and Information and Automation Technology. The co-location of research teams with industry partners and the injection of international collaborators enables extraordinary research breakthroughs to have translational impacts that can benefit economies, peoples and societies on a potentially enormous scale.



About InnoHK



HK\$10 billion

Hong Kong government's investment



28

Research laboratories



2000

Researchers



6

CUHK's research laboratories



210*

CUHK researchers



12

Economies (including Hong Kong)



30+

Non-local institutions

(Source: InnoHK and CUHK)

*Updated as at January 2023

RESEARCH AND INNOVATION IN NUMBERS

In six decades, CUHK has become a leading institution of higher learning known internationally for its dedication to education, global engagement, as well as impactful research and innovation.

12th IN ASIA

38th IN THE WORLD

QS WORLD UNIVERSITY RANKINGS

7th IN ASIA

45th IN THE WORLD

TIMES HIGHER EDUCATION RANKINGS

26th IN ASIA PACIFIC

1st IN HONG KONG

REUTERS' ASIA PACIFIC'S MOST INNOVATIVE UNIVERSITIES

Top 100

WORLDWIDE UNIVERSITIES GRANTED U.S. UTILITY PATENTS

74% CUHK research

RATED AS WORLD-LEADING OR INTERNATIONALLY EXCELLENT

(RESEARCH ASSESSMENT EXERCISE 2020, UGC)

Most Patents Granted

UNIVERSITY IN HONG KONG IN 4 CONSECUTIVE YEARS

(SINCE 2017-18)

2nd IN HONG KONG

THE ACADEMIC RANKING OF WORLD UNIVERSITIES (ARWU)

1st IN ASIA

53rd IN THE WORLD

U.S. NEWS & WORLD REPORT

17th

IN THE WORLD

TIMES HIGHER EDUCATION MOST INTERNATIONAL UNIVERSITIES

* Updated as at 1 February 2023



In 2021–22

419

Patents filed

264

Patents granted

45

Licences granted

Total numbers to date

3700+

Patents filed

1500+

Patents granted

1000

Inventions

63

Technology start-up companies

141

Student start-up projects

18

Social enterprises

245

Community-based
knowledge transfer projects

HOLISTIC SUPPORT CONDUCTIVE TO TRANSLATIONAL RESEARCH

■ Professor Sham Mai-har



Dedicated teams have been set up to render practical assistance to CUHK researchers in translating research output into positive societal impact. The Office of Research and Knowledge Transfer Services has been providing comprehensive support, such as assisting academics in locating research grants and preparing research contracts, offering support for intellectual property (IP) development and licensing, and facilitating collaborations with external parties, and formulating research ethics policies.

The Office of Innovation and Enterprise aspires to create an innovation ecosystem that fosters interactions among industries, investors, the government and academia, thereby accelerating CUHK's innovation and societal impacts. The Office for Greater Bay Area Developments works in collaboration with governments across the GBA to fuel innovation development and promote integration between Hong Kong and Guangdong Province in this exciting initiative to build an integrated megapolis in southern China.

TR at CUHK, a wholly owned subsidiary of the University, is the holding vehicle behind the six InnoHK Centres ("TR" stands for translational research) to facilitate the University's promotion of innovation and commercialisation of research through the Centres.

"Many of the world's most important translational research emerges from outstanding frontier discovery conducted at universities. These InnoHK Centres will translate the outputs of CUHK's world-class research into to new products, novel solutions and expand our technology applications to markets which will enable more people to benefit from the research we do," says Professor Sham Mai-har, Pro-Vice-Chancellor (Research) and Choh-Ming Li Professor of Biomedical Sciences.

Excel with purpose and responsibility

As a comprehensive research university, CUHK sees the commercialisation and translation agenda as

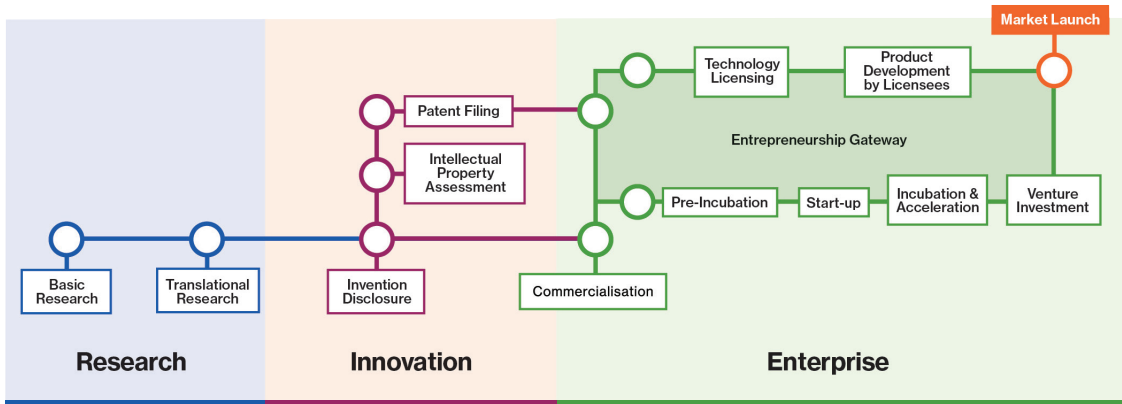
a vital part of its mission. “We focus on integrating research, innovation and enterprise into a dynamic and productive continuum, a superhighway that enables the translation of research into tangible benefits and the delivery of innovation to the world,” says Professor Sham.

As co-chairperson of the Sub-group on Research and Innovation for the *CUHK Strategic Plan 2021-25*, Professor Sham was a major part of driving the University’s new conceptual roadmap approach to the innovation agenda. Under this approach, CUHK sees the integration of research, innovation and enterprise forming a dynamic and productive continuum delivering tangible benefits to society.

Under the theme of “excellence with purpose and responsibility”, the *Strategic Plan* reflects the University’s determination to create and nourish an ecosystem that is conducive to the flourishing of knowledge creation, technology transfer and global community.

“Innovative Biomedicine” is one of the strategic areas outlined in the *Strategic Plan*. With the inception of InnoHK and the government’s plan to set up an InnoLife Healthtech Hub at the Lok Ma Chau Loop Hong Kong-Shenzhen Innovation and Technology Park, the development path of translational biomedicine has never been more promising. CUHK will tap into these opportunities and resources to build on its successes to make an important contribution to the innovation agenda.

The grand challenges facing the world require global collaboration. Strategic engagement with mainland China and the world will continue to be the University’s priority. As a comprehensive research university, CUHK is committed to fostering interdisciplinary research with its international counterparts to facilitate holistic human health. This issue of *CU Bulletin* takes the University’s three health-focused InnoHK Centres to tell that story.



A dynamic and productive continuum delivering societal benefits

1

As if it were newly born

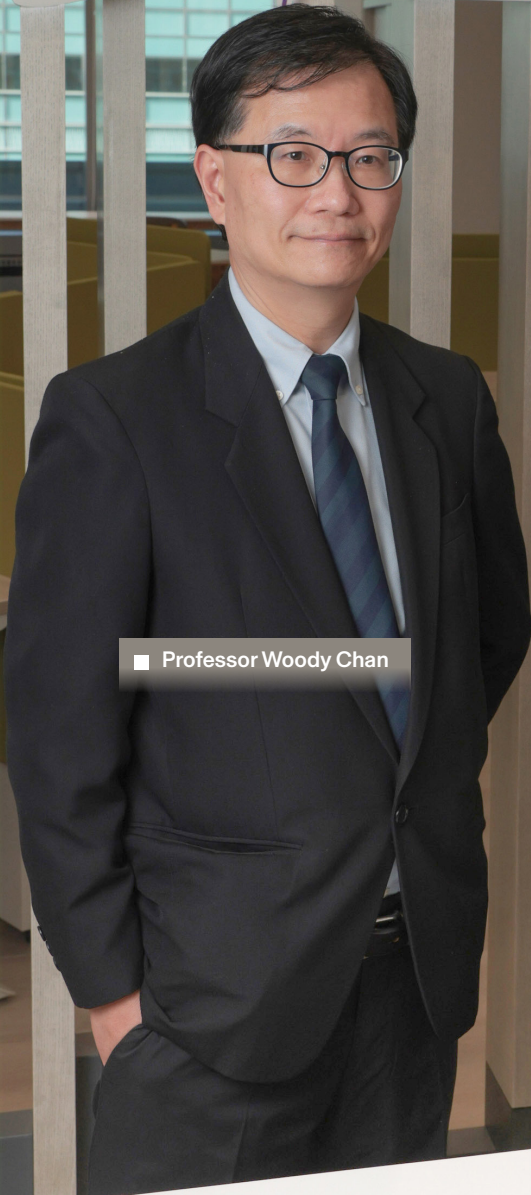
Regenerative medicine experts
offer hopes of recovery and wholeness





CNRM

Center for Neuromusculoskeletal
Restorative Medicine Limited



■ Professor Woody Chan



■ Professor Patrick Yung



The Ancient Greeks thought that among all species on earth, humans are the noblest and most beautiful. A body of strength, balance and beauty results from perfect orchestration between nerves, muscles and bones. Any of these parts failing would be the precursor to illness and ageing. Consequently, repairing the human body—making the damaged tissues and organs whole again—becomes the eternal hope of mortal human beings and the ultimate goal of medical science.

Opened last March at the Hong Kong Science Park, the Centre for Neuromusculoskeletal Restorative Medicine (CNRM) aims to make the injured whole again. The team finally got the good news at the end of January 2022 that the establishment of CNRM had been approved, after two years of rigorous interviews and proposal reviews.

Joining forces with Karolinska

Professor Patrick Yung, CNRM's director and chairman of the Department of Orthopaedics and Traumatology,

teamed up with Professor Woody Chan, who works at the School of Biomedical Sciences and is now the Centre's co-director. They identified 12 medicine, biomedical sciences and engineering researchers at the University.

Together with 12 researchers from its overseas partner, Karolinska Institutet in Sweden, the team works on 23 research projects encompassing stem cells¹ and cell-based therapies, tissue engineering² and modelling, cellular and molecular biology, clinical translation, and enabling technologies.

"In terms of musculoskeletal research, CUHK is really top-notch in the world. For research into neural systems, Karolinska is particularly strong. Working with them can strengthen our capability in that regard," says Professor Yung. In February 2022, a month after the Centre was approved, the CUHK and Karolinska researchers met online, with Vice-Chancellors from the two universities officiating. "The presence of two Vice-Chancellors in the same online meeting speaks volumes of the importance both institutions attach to CNRM," says Professor Chan.

Medicine of and for the future

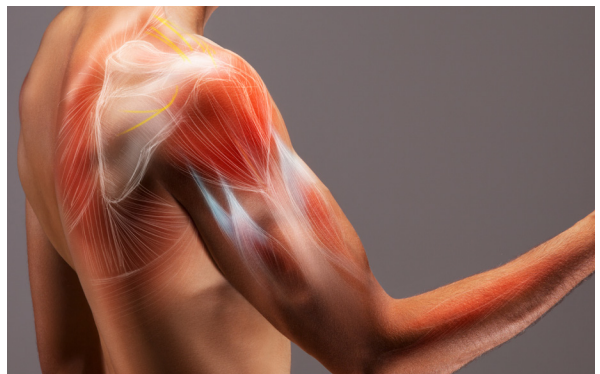
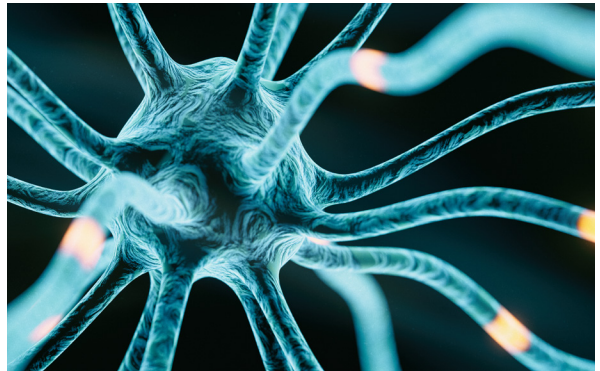
Compared with other InnoHK Centres, CNRM is still in its formative days. An orthopaedic surgeon specialising in sports medicine, Professor Yung deploys stem cells to treat osteoarthritis and cartilage damage as part of his research at CNRM.

“In a clinical setting, we are faced with a multitude of irresolvable issues, ageing being one of them. It can be neural degeneration, Parkinson's disease, dementia, knee osteoarthritis, tendinopathy, frozen shoulder or tennis elbow. We'd like to reverse that—that is, to make the tissues and organs young and healthy again,” he says.

Humble and soft-spoken, Professor Chan is an expert in developmental biology and embryology, focusing on the development of the peripheral and enteric nervous systems. At CNRM, part of his research involves tissue engineering. He brings miniature, crystal-clear tissue chips to our interview: organs-on-chips created by engineers, which mimic human physiology. Cells can be placed in the hair-fine microchannels within the chips so that researchers can study pathologies and cell behaviours.

“Originally, this was used for studies of blood vessel formation and cell migration. Now it is used to model the peripheral nervous system. We put severed nerves in and feed them with different ingredients, comparing the rates at which they grow in different scenarios. In this way, we can find out what kind of environment is most conducive to nerve recovery.” He explains these chips can speed up the research process and minimise the use of animals. The research conditions are fully controllable, and the experimental process and outcome stabler and more reliable.


“Another colleague is doing something even more interesting: he is growing organs on these chips, studying ways to treat the damaged organs. In other words, that is body research outside the human body,” says Professor Chan. “You could even grow liver or muscles. Everybody wants to be the first to achieve this.”



Exchange of ideas begets wisdom

On top of hitting the goals regarding theses, patents, start-ups and talent as put down in proposals, the two professors are ardently hoping there is synergy between them and their overseas researchers. Scientific breakthroughs need financial backing, but the soul of novelty is made up of resolve to push the limits of knowledge and go one step further, as well as creative sparks that are born out of exchange of thoughts and ideas.

“Researchers have their specialisations and strengths. We will work closely together, hoping to engender something new,” says Professor Yung. Enabling technologies are one of CNRM's research programmes, and a locus for researchers from different disciplines. Scaffolds, for example, can be used in cartilage and tendons, so engineers designing the scaffolds work with people researching



those body parts. "Besides devising structures and technologies for the team's use, we earnestly hope to pass them forward and benefit other scientists. These technologies may not be worthy of translation or large-scale production, but it would be marvellous if more scientists can use them," says Professor Chan.

Cooperation need not be a grand narrative; the ramifications of tiny, everyday collaboration can even be more lasting and far-reaching. Professor Chan gives an example: the nervous system is a huge research area. In CNRM, the researcher working on the peripheral nervous system can discuss research goals and processes with another research group working on the spinal cord, so both can consider their respective areas from a holistic point of view. The duo can come together with the engineer in charge of the enabling technology to form an awesome collaboration. "One plus one may not equal to two; it can be infinite. With these apt reminders from each other, the research undertaking can be brought up to next level."

Professor Yung adds: "As you present your findings, your peers might say they have adopted another method 10 years ago, so picking that up could save

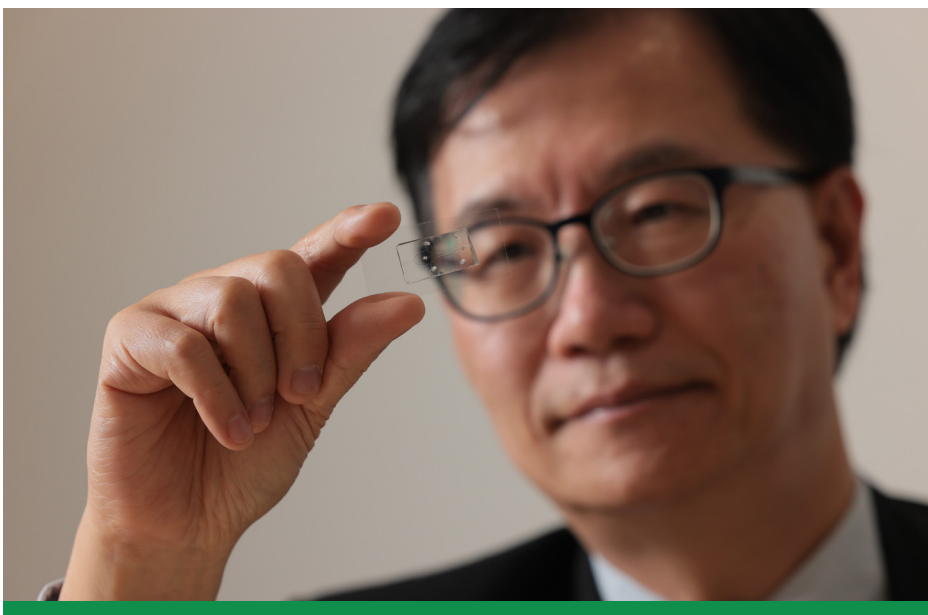
you a lot of time. We hope this platform will allow every one of us to benefit from collective wisdom."

An entrepreneurial turn

Turning from the ivory tower to entrepreneurship, the two professors leading CNRM realise there is much to learn. "From the early days of incubation to now, I have learnt a lot. Research translation is not as simple as it sounds. We have spent a lot of time negotiating patents, collaboration agreements and intellectual property.

"Patents are important. We didn't realise that in the past, and many research outcomes remained unpatented. Indeed, everything, however infinitesimal, should be patented. Only then can the intellectual property of the University and, indeed, Hong Kong be protected," says Professor Yung.

Professor Chan has also had a change of mindset. "I used to focus on doing research and getting funding, but now, from day zero, I think: is it possible to get the research off ground, apply for patents or open start-ups? Such thoughts never ever crossed my mind before."



Professor Chan looks at a crystal-clear tissue chip

Going step by step

In the past few years, the government has committed more than HK\$100 billion to boosting the local innovation and technology scene. Would the professors, who have witnessed the city's scientific and technological development, and negotiated with the authorities for years, cast a vote of confidence on the prospect of Hong Kong becoming an international innovation and technology hub?

"For two consecutive years, the policy address has laid down the vision of turning Hong Kong into an innovation hub," says Professor Yung. "This is unprecedented. So, in the first place, this is policy-driven. Second, in terms of investment, HK\$10 billion has been put into the InnoHK platform and, in total, more than HK\$100 billion has been pumped into the sector. These measures will stand us in good stead.

"That said, they will need to overcome a dozen issues. To start with, the world has ground to a halt due to the coronavirus pandemic. Hong Kong is an expansive, export-oriented economy; if we want to excel, we have to step up our game. Second, we have to compete with the rest of the world for talent. Last but not least, facilities count. Although it has been talked about for a long time, a good manufacturing practice (GMP) laboratory is nowhere to be found in Hong Kong.

"Fortunately, the University has been building one, and the first ever GMP lab will soon open at the Hong Kong Institute of Biotechnology."

¹Stem cells are primitive human cells that can differentiate into different types of cells, such as liver, blood and muscle cells. As the earliest type of cells, they can become virtually every type of tissue and organ. As a result, they are widely used in medical settings, especially in repairing and replacing injured tissues.

²Tissue engineering is a technology and method which makes use of principles and techniques of engineering and life sciences to cultivate tissues and organs outside the body, in order to mimic the human physiological environment or replace the damaged tissues and restore health. Regenerative medicine is a discipline and a grand medical horizon, and can be achieved in different realms, such as cells and genes. Its overarching aim is to reverse illness and ageing. Regenerative medicine is a frontier discipline, whereas tissue engineering has attracted much attention in the recent decade. In the past, they usually went in tandem with the post-cancer rebuilding of organs and tissues. These days, tissue engineering goes hand in hand with regenerative medicine.



The setting up of CNRM, with its thematic and multi-disciplinary nature, and collaboration between two world-class research institutions, provide a unique strength to accelerate R&D breakthroughs in neuromusculoskeletal disease. It will certainly strengthen the stature and commitment of Hong Kong as an advanced R&D hub in the region.



**Professor
Patrick Yung**

**Director of the Center for
Neuromusculoskeletal
Restorative Medicine**

2

Where the MagIC happens

Targeting the trillions of microorganisms in the human gut may yield treatments for conditions as diverse as colorectal cancer, autism, eczema, obesity, depression and long COVID





■ Professor Francis Chan

■ Professor Siew Ng

It was over a cup at Pacific Coffee that gastroenterology professors Ng Siew Chien and Francis Chan Ka-leung shared a conversation five years ago, and sketched out their idea for Hong Kong's next centre of innovation. In time-honoured fashion, their first plan was on the back of a napkin.

At the time, genomics were all the fashion. But their concept is to design personalised treatments and analytics based on the gut microbiome weighs that call our body home. It transpires that our microorganisms' DNA outnumbers our own DNA, which makes us more microbes than human.

"We think this era is the era of the microbiome," Professor Ng, who is an expert in inflammatory bowel disease and holds a post in CUHK's Department of Medicine and Therapeutics.

Because of the sheer volume of bacteria—gut microbiome weighs around 5 lbs in a human body—targeting the microbiome has the advantage that it can be manipulated. Whereas we inherit our genes and DNA as our birthright, our internal biome is influenced by our environment and behaviours.



Go with your gut

Despite that potential, the professors had to push hard before their vision was realised. "People were skeptical—nobody was interested in this idea," Professor Chan, the dean of CUHK's Faculty of Medicine, concedes.

They persisted, however, and now their ideas have borne fruit. MaGIC—full name the Microbiota I-Center—has set foot at InnoHK, with a mission to developing novel classes of microbiome diagnostics and therapeutics.

Many if not most diseases can be traced back to disruption of the microbiome. While we have limited control over which of our genes are regulated, and how genes are expressed, our microbiome can be manipulated with direct medical intervention.

"All human diseases we can think of are related to some abnormality in the microbiome," Professor Ng says. "We call the gut the second brain. Autism, depression, even Alzheimer's and eczema are being shown to be due to changes in the microbiome."

Unravelling the microverse of bacteria

MagIC has teams now working on research into the early-life gut health of infants and children, which they consider the “golden age” of microbiota manipulation. Early intervention can ward off conditions as or before they develop, at a time that gut health is more malleable.

Other MagIC researchers are investigating the physiological role that bacteria play in influencing obesity, metabolic disorders, and Type 2 diabetes. Gut bacteria can disrupt digestion, vitamin synthesis and the formation and oxidation of fatty acids. The exact interaction between bacteria and obesity is far from perfectly understood, but a fertile field of research.

There's a very clear link between the digestive system and inflammatory bowel disease, including conditions such as Crohn's disease and ulcerative colitis. Environmental factors play a much-greater role in any pathogenesis, with, for instance, early-childhood overuse of antibiotics a potential contributing factor for bowel conditions in later life.

MagIC has had its greatest early success during the pandemic, the research team showed that microbiome markers are good indicators of whether a patient would develop a serious case of Covid-19, or progress to “long Covid”.

“We were the first in the world to show that the microbiome profile determines if you'll get really sick from Covid or not,” Professor Ng explains. “If you have long Covid, your gut microbiome profile is very different. Some people have brain fog, chronic fatigue syndrome, the different types of microbes can explain that.”



Making magic of faeces

MagIC is also attempting to improve the delivery of intestinal microbiota transplants. Such faecal transplants have a long history in Chinese medicine, Professor Ng notes, with “yellow dragon soup” essentially a faecal solution that was used as a traditional treatment for food poisoning and other stomach maladies.

Currently, faecal transplants have been approved in the US in treating recurrent infections from the *Clostridioides difficile* bacterium, an infection that often doesn't respond to antibiotics but can cause persistent, even fatal, diarrhoea and colitis.

Professor Ng recalls treating her first patient in Hong Kong with the condition. The 88-year-old man had sought treatment in mainland China without success, and was afflicted with crippling diarrhoea that forced him to the toilet 10 times per day. After Professor Ng and her team treated the patient with a faecal transplant from his son, the patient saw an immediate benefit, and was essentially cured of the condition within six months.

"It was kind of miraculous," she recalls. "You give people back the good bacteria they have lost over time, and you give people the chance of overcoming the symptoms."

Every year, some patients in Hong Kong suffer through the same condition. Hopes are high that the Hospital Authority will approve the CUHK faecal-transplant treatment for use in the Hong Kong health system. "If successful this will be a major breakthrough," Professor Chan says. "We can make use of our innovations to tackle a potentially deadly disease."

The MagIC team is now conducting clinical trials on the use of faecal transplants to treat obesity, Type 2 diabetes, depression and autism, with the autism studies likely to kick into high gear in mid-2023. Such transplants also appear to enhance immunotherapy and the treatment of cancer. MagIC is also developing a stool bank as well as a centralised system for donor screening, to help with the time-consuming and costly issue of matching patients with faecal donors.

CUHK hosted a microbiome summit in January 2023, bringing together academics, entrepreneurs,

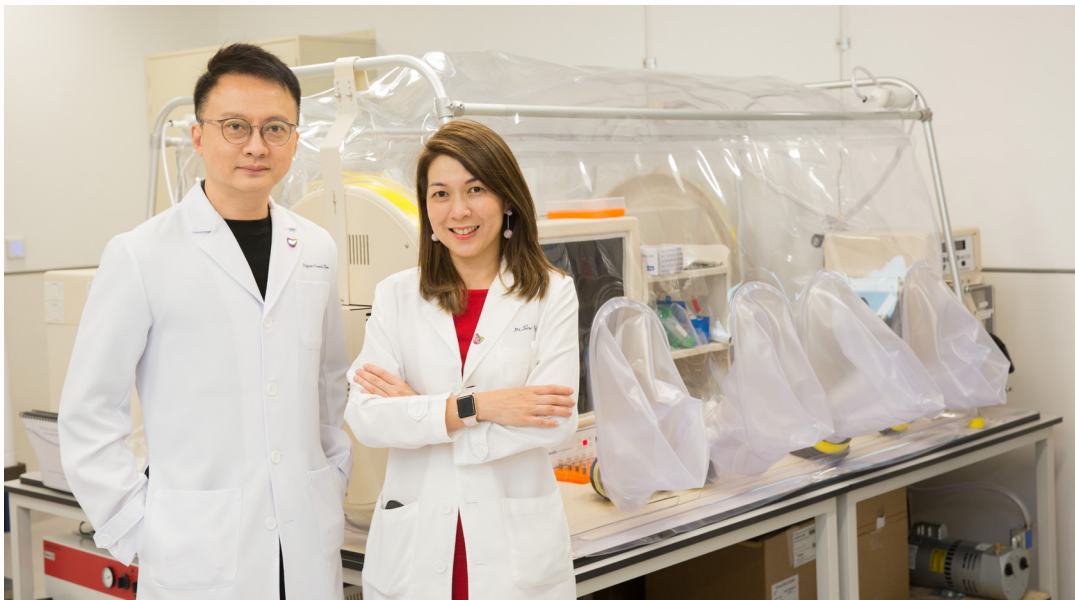
policy makers and medical experts from around the world. The MagIC team has worked regularly with their collaborators at the Universities of Cambridge, Chicago and Melbourne, who will attend, as will participants from the the drug-development industry.

That fateful meeting a half-decade ago laid a solid foundation, with the pending research at MagIC likely to yield results in the next few years. "This wave is not just a gut feeling," Professor Ng says. "It has emerged to be true."

Transforming microbiome research into macro impact

In late 2019, MagIC's established its first spin-off biotechnology company, GenieBiome Ltd. GenieBiome is truly independent, however, with separate sources of funding; the spin-off is entirely funded by private seed and angel investors.

Still, it's a challenging process. It has not to date been much of a feature of academia in Asia to build on ideas generated at a university to create a standalone



company. With the university structured to provide education rather than create independent companies, carving out a spinoff requires persistence.

“Commercialisation and entrepreneurship are buzzwords—execution is the real challenge,” Professor Chan says.

In October 2022, the team launched the GenieBiome Molecular and Microbiome Laboratory in Wan Chai to provide novel gut-microbe diagnostics. The lab’s initial focus is to run a stool-sample test that can provide early detection warning for colon cancer.

Colorectal cancer is the No. 2 source* of cancer deaths in Hong Kong, behind only lung cancer. But all too often colon cancer is only detected in the late stages, when it is very difficult to treat and often little can be done.

The testing is earlier and quicker to detect cancer. It’s also less-invasive and considerably cheaper than a colonoscopy.

There’s also scope to use the lab to test for childhood maladies, since getting a stool sample from an infant or child is far easier than drawing blood or other invasive measures. The lab, using technology licensed from CUHK, also has a second arm working on therapeutics, to augment the diagnostics side.

“Commercialisation is not just about profit, it’s about turning your ideas into something that can benefit society,” Professor Chan says.

GenieBiome now has a staff of more than 100. Its Wan Chai lab augments its operations in mainland China, Singapore and Malaysia, while it also has expansion to the UK and the US in mind.

*Centre for Health Protection (2022), *Colorectal Cancer*. Department of Health. Hong Kong government, <<https://www.chp.gov.hk/en/healthtopics/content/25/51.html>>.



“

MagIC is determined to harness and empower microbiome into cutting-edge innovations that will transform lives of patients and their families.

We are committed to developing novel classes of microbiome diagnostics and therapeutics that will accelerate Hong Kong into a world-class microbiome biotechnology hub.

”

**Professor
Ng Siew Chien**

**Director of
Microbiota I-Center**

3

The DNA of innovation

Deciphering genetic clues for novel diagnostics, from safeguarding foetal health to screening for cancers



CENTRE FOR NOVOSTICS

■ Professor Dennis Lo

■ Professor Allen Chan

Empathy opens the door to innovation. Previously, expectant mothers needed to make a stressful decision to have an invasive test to detect Down syndrome, one that involves a risk of miscarriage. From the time when Dennis Lo Yuk-ming was a medical student at Oxford University, he has been looking for a non-invasive method that doesn't hurt the foetus.

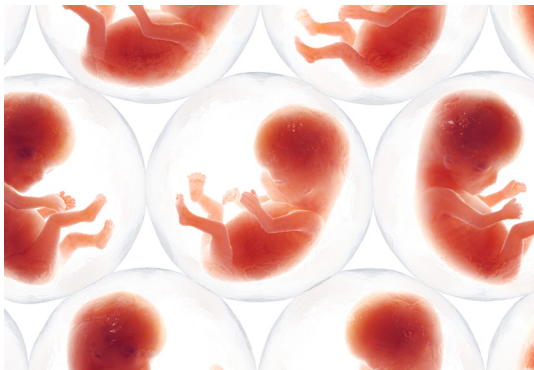
The quest hasn't been easy for him. He was frustrated to find very few foetal cells in maternal blood. "Scientists at that time generally assumed that DNA

belonged within a cell. It was when I shifted my focus to cell-free DNA fragments that I discovered presence of foetal DNA in maternal plasma in 1997," says Professor Lo, associate dean (research) of CUHK's Faculty of Medicine, who's often referred to as the "father of Non-invasive Prenatal Testing (NIPT)".

In 2011, the discovery was translated into a non-invasive clinical prenatal test, subsequently marketed under the brand name safeT21, for foetal chromosomal aneuploidies. It has revolutionised clinical practice

in prenatal testing globally. Circulating DNA blood testing can also be applied to cancer screening. In 2017, Professor Lo's team demonstrated that plasma Epstein-Barr virus (EBV) DNA analysis is useful in screening for asymptomatic nasopharyngeal carcinoma (NPC).

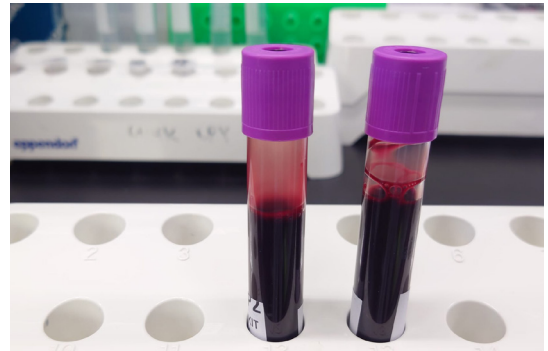
The leading scientists behind these milestones, professors Dennis Lo, Rossa Chiu and Allen Chan, have come together to establish the Centre for Novostics at InnoHK. The name stands for "novel diagnostics", which means that the centre aims to innovate in molecular diagnostics, particularly prenatal testing and cancer diagnostics.



A paradigm shift in prenatal testing

"As foetal DNA fragments exist randomly outside blood cells, it's difficult to count chromosomes with conventional methods to find trisomy 21, an additional chromosome leading to Down syndrome," says Professor Lo.

Eventually, he identified the ratio of chromosomes via massive parallel sequencing to efficiently use the information stored in plasma DNA. The accuracy is over 99%. The technology has since been translated into safeT21.



(Source: Centre for Novostics)

Professor Lo co-founded Xcelom in 2014 to commercialise the test. The name comes from the term "extracellular genome", which means genomic DNA swimming outside the blood cells are measured.

Since its introduction to clinical practice in 2011, NIPT has been widely adopted globally and helped millions of expectant mothers every year. "The blood test can be done as early as week 10 of pregnancy, whereas an amniocentesis has to be performed no earlier than week 16," Professor Lo explains.

Studies have shown that safeT21 is more accurate compared with the traditional Down Syndrome screening test, resulting in an almost 30% reduction in the number of invasive procedures such as amniocentesis and chorionic villus sampling performed in Hong Kong.

Life-saving cancer screening

Just as a growing foetus sheds cell-free DNA into maternal blood, so tumours do the same to their host's blood. A 20,000-person study led by Professor Lo and Professor Allan Chan revealed that NPC, a common cancer in Hong Kong and southern China, can be detected among asymptomatic people with the help of a plasma EBV DNA test.

As early NPC is relatively asymptomatic, approximately 80% of unscreened patients are diagnosed with advanced NPC, which is more difficult to treat than during the early stages. NPC is closely associated with infection by the EBV. The presence of plasma EBV DNA consisting of short DNA fragments released by NPC cells will help identify asymptomatic NPC patients.

Current applications of circulating cancer DNA analysis focus on guiding treatment options and monitoring responses to them. But there has been little information on whether a small asymptomatic tumour could be detected through analysis of circulating DNA. "Our large-scale clinical trial shows for the first time that plasma DNA analysis is useful for detecting early asymptomatic NPC. Even small tumours can release enough tumour DNA to allow sensitive detection of very early cancers," says Professor Chan, chair professor of chemical pathology.

With this technology, 70% of NPC patients can be identified at stages 1 and 2, when there is a much greater likelihood of successful treatment, with a survival rate 10 times higher. In 2017, the landmark findings were published in the *New England Journal of Medicine*.

The study has laid the foundations for using liquid biopsy to screen for other types of cancer. Professor Lo adds, "I co-founded Take2 Health to offer an NPC screening service in Hong Kong." He is also the scientific co-founder of Grail, which has started offering a detection test for 50 cancers, known as Galleri, that is available in the UK and US. Time magazine listed Galleri as one of the best inventions in 2022.



Observing an Illumina flow cell

Eye on excellence

The research team has recently discovered unexpectedly long cell-free DNA in plasma. "The longest I've seen is 24,000 base pairs on cell-free DNA. Previously, most researchers mainly focused on those of around 160 base pairs," says Professor Lo. The breakthrough has shown the feasibility of making a genomic map with far fewer molecules by using superlong cell-free DNA. "It's like we were used to short messages like WhatsApp to work out the foetal and cancer genomes. But now we can peruse the genomic map, like reading Word documents."

With the founders' proven 20-plus-year track records in genomics and diagnostics research, the Centre for Novostics plans to extend its work to single gene disease and other pregnancy-associated conditions. It will employ a combination of genomic, epigenomic, transcriptomic and fragmentomic technologies to tackle bottlenecks in cancer diagnostics and investigate the tissue origin of malignancy by circulating

nucleic acid analysis, particularly for cancer types prevalent in Hong Kong, mainland China and Asia.

These research areas will accelerate the application of liquid biopsy and promote Hong Kong as a leading global molecular diagnostic centre. Leveraging the city's well-developed public healthcare system and its strategic location, with easy access to other major cities, Novostics envisages creating a conducive environment for collaborations with other renowned research institutes and universities. For instance, it collaborates with Oxford University to investigate whether a plasma nucleic acid test can identify toxæmia in pregnant women.

Stepping up for the innovation tango

As a clinician scientist and entrepreneur, Professor Lo finds innovation and entrepreneurship highly correlated. "When I'm doing research, I envisage its future clinical applications and how it may benefit

human health. That's the essence of translational research: to translate basic research discoveries into social impact. Besides royalty income from the patents that have been licensed, the revenue from entrepreneurship also supports my research projects."

This virtuous cycle also benefits the R&D ecosystem and strengthens the talent pool. "This is a prime time for biotechnology research and innovation in Hong Kong. We are seeing more opportunities for the young as the city prepares to become a health technology hub in the Greater Bay Area."

Novostics is a breeding ground for R&D talent, including undergraduates of the Global Physician Stream, PhD students and postdoctoral fellows of the Faculty of Medicine. "We aspire to groom clinician scientists to bring scientific advances to patients," he says. The centre also spins off start-ups such as Take2 Health.

Entrepreneurship is highly encouraged at the University. Professor Chan says, "CUHK has the largest intellectual property income among the universities in Hong Kong. The Office of Research and Knowledge Transfer Services (ORKTS) is highly efficient in IP prosecution and licensing. The IP-income sharing regulation is one the most competitive in the world. Those are pretty much the reasons behind the good innovation and entrepreneurship atmosphere on campus."

The Hong Kong government's InnoHK initiative provides an unprecedented level of support for R&D. With the government's generous funding and start-of-the-art technology facilities at the Science Park, Professor Lo says that his team has been given the resources to accelerate translational research and compete with the best laboratories in the world.

"The government's staunch support demonstrates its vision of the importance of innovation and the technology industry for Hong Kong economy in the next two decades," adds Professor Chan.



I'm excited to be part of the InnoHK initiative and witness the rapid evolution of the biotechnology ecosystem in the city. We strive to provide leadership in nurturing local talent for the biotechnology industry and to reinforce the importance of interdisciplinary collaborations in translating scientific knowledge into clinical applications.



**Professor
Dennis Lo Yuk-ming**

**Scientific Director of
the Centre for Novostics**

Innovating for Impact

The National 14th Five-Year Plan highlights an important aspiration for Hong Kong to be positioned as an international I&T hub connecting the world with the rapidly emerging research and innovation ecosystem of the GBA. Hong Kong's higher education system, with its concentration of highly-ranked, world class universities is set to play a major role in this ecosystem.

Over the past five years, the Hong Kong government has invested over HK\$150 billion in I&T development, with approximately one-third dedicated to R&D, with new initiatives spanning areas such as capital, talent and infrastructure.¹ The gross domestic expenditure on R&D (GERD) in Hong Kong in 2021, representing 0.97% as a ratio to the GDP, amounts to HK\$27.8 billion, and higher education sector accounts for HK\$14.7 billion out of it. The GERD indicates an increase of 5% compared with the corresponding figure in 2020.²

In the 2022 Policy Address, a series of I&T initiatives were announced like earmarking HK\$10 billion to launch the Research, Academic and Industry Sectors

One-plus Scheme (RAISe+ Scheme) for promoting commercialisation of universities' outstanding research and development outcomes for pushing ahead the "from 1 to N" transformation, as well as pressing ahead with construction of the Hong Kong-Shenzhen Innovation and Technology Park in the Lok Ma Chau Loop.³

The city's universities have been major beneficiaries of the government's I&T agenda, and the higher education sector is co-developing a range of world-class facilities including national-level laboratories and research centres supported under the InnoHK umbrella.

Talent pooling for a science-based future

In the Times Higher Education World University Rankings 2023, CUHK is among the five local tertiary institutes listed in the world's top 100. With its unique mission to bring together China and the West, CUHK is one of the most international and inclusive universities to attract talent from around the world to develop the city's innovative capacity.



CUHK boasts a galaxy of distinguished scholars and researchers who are highly regarded authorities in a range of fields. The University's six InnoHK Centres, covering health, biomedicine, robotics and artificial intelligence (AI), demonstrate how our world-class research discoveries are igniting the spark of innovation and creating translational impact.

Unleashing potential in innovation and entrepreneurship

CUHK has a proven track record in converting research outputs to commercialised products and fostering cross-border research collaborations. Besides founding many start-ups and spin-offs, CUHK community has also seeded the largest number of the territory's unicorns (start-ups valued at over US\$1 billion), including SenseTime, SmartMore and GeneHarbor.

Hong Kong's new emphasis on the innovation agenda represents an unprecedented opportunity for CUHK to accelerate its commercialisation and applied research endeavours.

Translational biomedicine will continue to be a pillar of strength in CUHK research and

innovation as exemplified in Health@InnoHK. Another three Centres of AIR@InnoHK, which aspire to improve surgical precision, help the speech impaired and provide automated logistics, will be covered later on.

Humanistic spirit of innovation

2023 marks the arrival of CUHK's diamond jubilee celebrations. From its humble origins six decades ago, CUHK has been at the forefront of cultivating generations of talent and contributing to the development of Hong Kong, the nation, and the intersection of innovation between China and the rest of the world.

The University was founded with a commitment to whole-person education and cultivating future leaders who embody the spirit of CUHK's motto "through learning and temperance to virtue". As Hong Kong transitions to a knowledge-based economy and rallies around the promise of innovation and entrepreneurship, this educational philosophy offers a supply of leaders with both the intellectual and the moral foundations to drive a people-centric focus on innovation.

¹The news.gov.hk team (2022). HK on the right track for I&T. Information Services Department. Hong Kong government.

²The Science and Technology Statistics Section (2022). Statistics on innovation activities for 2021. Census and Statistics Department. Hong Kong government.

³GovHK (2022). Continued increase in Hong Kong's gross expenditure on research and development in 2021. Information Services Department. Hong Kong government.



Appointments

Council members



Mr Dominic Pang Yat-ting



Mr Nicholas Chan Hiu-fung



Dr Barbara P.L. Kwok



Mr Enders W.H. Lam



The Honourable Tang Ka-piu



Professor Helen Meng Mei-ling



Professor Chu Ming-chung



Ms Sonia C.M. Cheng

| | | Name | Period |
|--------------|--------|-------------------------------|-----------------------|
| New | Member | Mr Dominic Pang Yat-ting | 1.5.2022—30.4.2025 |
| | | Mr Nicholas Chan Hiu-fung | 1.6.2022—31.5.2025 |
| | | Dr Barbara P.L. Kwok | 4.7.2022—3.7.2025 |
| | | Mr Enders W.H. Lam | 4.7.2022—3.7.2025 |
| | | The Honourable Tang Ka-piu | 28.7.2022—27.7.2025 |
| | | Professor Helen Meng Mei-ling | 1.9.2022—31.8.2025 |
| | | Professor Chu Ming-chung | 1.9.2022—31.8.2024 |
| | | Ms Sonia C.M. Cheng | 1.11.2022—31.10.2025 |
| Re-appointed | | Professor Dennis Lo Yuk-ming | 1.9.2022—31.8.2025 |
| | | Mr. Charles Y.W. Leung | 30.11.2022—29.11.2025 |

University officers and senior staff



Professor Hector Chan Sun-on



Professor Vincent Mok Chung-tong



Professor Stephen Wong Heung-sang



Professor Anthony So Man-cho

| | | Name | Period |
|--------------|--------------------------------------|-----------------------------------|---------------------|
| New | Associate Vice-President (Education) | Professor Hector Chan Sun-on | 1.8.2022—31.7.2025 |
| | Master of SH Ho College | Professor Vincent Mok Chung-tong | 1.8.2022—31.7.2026 |
| | Head of United College | Professor Stephen Wong Heung-sang | 1.8.2022—31.7.2026 |
| | Dean of the Graduate School | Professor Anthony So Man-cho | 1.8.2022—31.7.2025 |
| Re-appointed | Master of Morningside College | Professor Nick Rawlins | 7.12.2022—6.12.2025 |

Emeritus professors

1.8.2022



Professor Cai Leizhen
Department of Computer Science
and Engineering



Professor Chan Wai-sum
Department of Finance



Professor Leo Cheung Kam-ching
Department of Philosophy



Professor Cheung Wai-man
Department of Decision Sciences and
Managerial Economics



Professor Shekhar Madhukar Kumta
Department of Orthopaedics and
Traumatology



Professor Albert Lee
The Jockey Club School of Public
Health and Primary Care



Professor Lin Ge
School of Biomedical Sciences



Professor Ma Lai-chong
Department of Social Work



Professor Catherine Alexandra McBride
Department of Psychology



Professor Clement So York-kee
School of Journalism and
Communication



Professor Wan Yau-heng
Department of Mathematics



Professor Veronica Wong Suk-ying
Department of Sociology

3.10.2022



Professor Chan Ngai-hang
Department of Statistics

8.10.2022



Professor Lee Sing
Department of Psychiatry

26.10.2022



Professor Vincent Lai Siu-king
Department of Decision Sciences and
Managerial Economics

26.10.2022



Professor Lee Ching-chyi
Department of Decision Sciences and
Managerial Economics

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Hong Kong SAR, The People's Republic of China

