

ScienceTalk

Advancing health through innovation

Technology is leading the way towards better prevention, diagnosis and treatment

Lim Chwee Teck

Singaporeans are living longer than ever, and the country has recently topped the world in life expectancy at 84.8 years.

Longer life can bring opportunities and continual contributions to the community, but this depends on one important factor: health. According to a recent Health Ministry report, 10.6 of those years will be spent in illness.

Thus, the challenge is not just to live long, but to live well, and live healthy during the later years.

This is critical not just for quality of life, but also because a rapidly ageing population with poor health can impose a tremendous burden on our healthcare system and economy.

It is an inevitable biological outcome – as a person ages, his physical and mental capacity decreases and his risk of disease increases.

But can this be slowed down?

Much effort has been placed on healthcare in terms of how to better diagnose and treat patients. But we need to move from healthcare to health.

Indeed, today's mantras for medicine are not just about early detection and precision therapy, but also prevention. To do so, we need new weapons in our all-out war against disease.

Health technology is an important part of this arsenal.

Technology has always played a key role in healthcare. Without technology, there would be no modern-day hospital. From the simple thermometer to the complex CT scan machine, we are heavily dependent on these technologies.

These devices are so ubiquitous that it is hard to imagine what healthcare would be like without them.

Moving forward, we can continue to innovate and create even better technologies, and radically change how diseases can be diagnosed, treated and prevented.

This is what the new Institute for Health Innovation & Technology (iHealthtech) at the National University of Singapore aims to do. Its mission is to address clinically unmet needs, develop innovative disruptive technologies and take them from the bench to the bedside.

As we work towards better prevention, early detection and more precise treatment for patients, our ultimate aim is to achieve longer and healthier lives.

At iHealthtech, we are developing technologies ranging from diagnostics for guiding precision treatment of patients, to smart sensors with artificial intelligence that can assist doctors in tracking patients' vital signs or nudge users towards healthier options through data collected, as well as imaging technology that can assist psychiatrists in detecting mental disorders early.

For example, we have developed microfluidic biochip technologies that can capture biomarkers such as circulating tumour cells or other products released from cells known as exosomes from a minute amount of blood, through what is known as liquid biopsy.

For cancer, we can perform molecular analysis such as DNA sequencing on these cancer cells or exosomes to detect any specific mutations that the patients may be suffering from. Some of these mutations can be treated with drugs.

Through such patient-derived information, we can administer the right drug to the right person at the right time, enabling more effective, personalised therapy unique to the patient.

In terms of prevention, we are exploiting the ubiquity of mobile and wearable devices and advances in

artificial intelligence to encourage healthy lifestyles and prevent the onset of chronic diseases, such as diabetes.

For example, we are developing apps and analytics that can perform automatic food image recognition and run recommendation algorithms, helping users to easily track and improve their diet using their smartphone cameras.

We are also involved in analysing step count data from over 100,000 fitness trackers. Our aim is to provide users with personalised interventions according to their physical activity, so that we can point them to options with healthier outcomes.

For better real-time monitoring of a patient's condition either in the hospital or at home, we have developed smart clothing that can boost wireless connectivity between wearable devices by about a thousand times. Patients wearing this clothing could have their health monitored by wireless devices with far longer battery lives, and have the wireless signals kept near the body for greater data privacy.

This opens opportunities for measuring patients' vital signs in everyday settings without inhibiting their freedom of motion, but which can alert loved ones or doctors when a situation arises.

Detecting mental disorders early has always been a challenge as psychiatry is the only speciality without a tool for objective diagnosis.

We are now using functional Near-infrared spectroscopy technology that is novel, affordable and safe. It exploits infrared light to detect subtle changes in brain function. Such changes can be associated with mental illness and can be especially helpful in early detection.

This technology overcomes a clinically unmet need by identifying mental illnesses with high accuracy.

The enhancement of diagnostic accuracy will help both doctors and patients make an informed decision on treatment.

Such innovative health technologies come about through close collaboration among scientists, engineers and clinicians. To eventually benefit patients, we are also engaging entrepreneurs and industry and regulatory agencies to bring these technologies from the laboratory to the hospital and the market.

Technology is here to stay and we should make the best of it, so as to achieve greater success in this long-drawn war against disease.

About the writer

Professor Lim Chwee Teck is director of the Institute for Health Innovation & Technology at the National University of Singapore.

He has been elected a fellow of the American Institute for Medical and Biological Engineering, International Academy of Medical and Biological Engineering and the Academy of Engineering, Singapore.

He is also an innovator and entrepreneur, and has co-founded six start-ups that commercialise technologies developed in his lab.

INNOVATIVE HEALTH TECHNOLOGIES



IMPLANTABLE ELECTRONIC DEVICES FOR DRUG THERAPY

These tiny, implantable wireless devices can deliver light into deep regions of the body to activate light-sensitive drugs for the precise treatment of various cancers, such as brain and liver cancer.



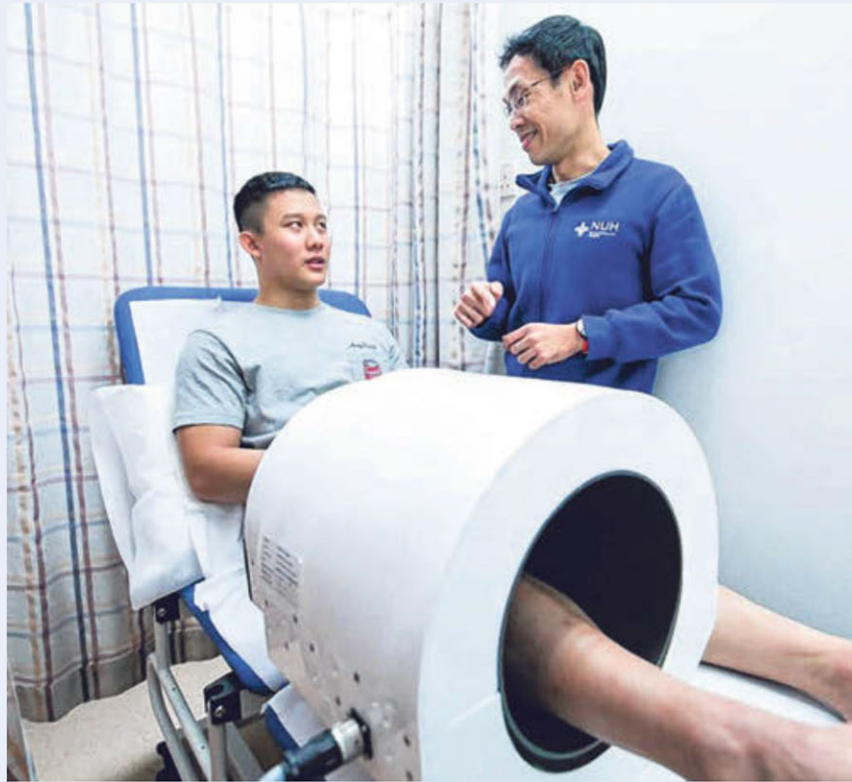
ORGAN-ON-CHIP PLATFORMS FOR DRUG TESTING

Microfluidic human organ-on-chip platforms can remove the reliance on animal models for the testing of drugs for illnesses such as cancer and diabetes.



E-SKIN FOR PROSTHETICS

Various types of e-skins, such as those that are transparent, stretchable, self-healing and with an exceptional sense of touch, are being developed for various applications, including more realistic prosthetic limbs that will help disabled individuals restore their sense of touch.



PHOTOS: NUS INSTITUTE FOR HEALTH INNOVATION & TECHNOLOGY

MAGNETIC SIMULATION FOR MUSCLE RECOVERY

Called MReGen, this novel medical device makes use of magnetic fields to simulate the biological effects of exercise and promote muscle recovery.



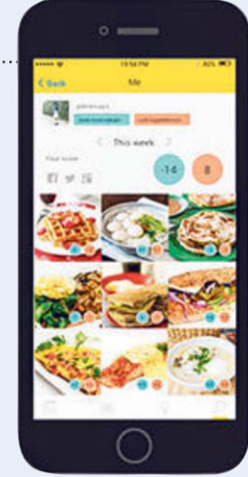
LIQUID BIOPSY BIOCHIPS FOR DISEASE DIAGNOSIS

Innovative biochips are being developed to detect diseased cells and cellular particles from small amounts of blood obtained through a blood draw. This can lead to quick and accurate diagnosis, as well as real-time monitoring of various diseases such as cancer and Alzheimer's disease.



SMART INSOLE FOR DIABETIC FOOT ULCER MANAGEMENT

With this smart insole, diabetic patients can use an app to identify where they are putting most pressure on their feet – allowing them to take a break from walking and reduce pressure on the affected areas. This could help cut foot ulcer rates among diabetics.



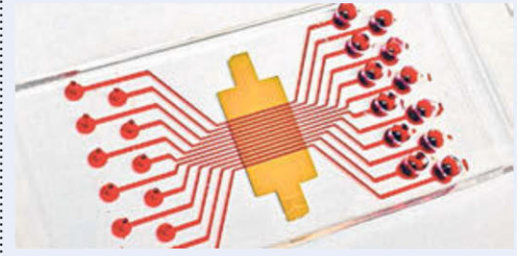
AI-DRIVEN APP FOR HEALTHY EATING

This mobile app recognises images of food, and runs recommendation algorithms to help users track and improve their diet.



WEARABLE PULSE MONITORING SENSOR

Highly sensitive and ultra-thin, this soft, flexible and stretchable microfibre sensor can be used to monitor a patient's vital signs and for bandage pressure-sensing during management of venous ulcers.



PRECISION THERAPY FOR PANCREATIC CANCER

By growing pancreatic cancer cells obtained from patients, drug tests can be performed to determine the most precise treatment and doses, so as to reduce side effects and improve survival.