1 August 2024

INAUGURAL NUHS SCIENTIFIC & INNOVATION SUMMIT
CHAMPIONS PREDICTIVE, PRECISE AND PERSONALISED CARE

From digital twin technology to leveraging AI in tackling obesity, the NUHS Scientific & Innovation Summit is a congregation of the brightest minds in cutting-edge medicine – with patients’ utmost care at heart

SINGAPORE — Hepatocellular carcinoma (HCC) is one of the most lethal cancers, but Mr Ang Chin Chay, 70, was in the dark about his dire condition, until he experienced a bout of fever following a vacation to Vietnam. He quickly sought medical attention for what turned out to be a Hepatitis A infection, transmitted through contaminated food he had consumed overseas.

It was a fortuitous encounter, as routine tests revealed abnormal liver function results. Mr Ang subsequently underwent scans, which uncovered HCC, a largely asymptomatic cancer in its early stages. This was unexpected as Mr Ang was known to have fatty liver, but not cirrhosis, the most advanced form of liver scarring.

“Patients with fatty liver – but without cirrhosis – are not routinely recommended to undergo liver cancer screening,” Dr Huang explained. “But in reality, we have discovered that nearly 40 percent of HCC cases related to fatty liver occur in the absence of cirrhosis.”

Mr Ang’s prognosis would have been poor if his condition had not been detected early, as patients who are diagnosed at a late stage have an overall five-year survival rate of less than 20 percent.

Improving the screening process for patients like Mr Ang through non-invasive tests and advanced imaging is the crux of Dr Huang’s work that he will be presenting at the NUHS Scientific & Innovation Summit, on 3 August 2024.

“We aim to risk stratify people with fatty liver into those who have a high risk of liver cancer and those who do not, and to pre-emptively develop better ways to identify these people early so that they can receive some form of curative treatment,” Dr. Huang explained.

Personalising care with the digital twin

Another project pushing the frontiers of medicine with digital innovations, is the Digital Twin programme led by Dr Gao Yujia, Assistant Group Chief Technology Officer, National University Health System.

The digital twin, which is based on imaging and other data from a patient’s own tests, is a virtual 3D anatomical replica of a patient’s organs, like the liver. The digital twin will
allow clinicians to transform what is usually a static scan image (such as an MRI scan), into a dynamic model that precisely recreates the shape and structural behaviour of the organ it replicates, enabling enhanced pre-surgery planning and more accurate intra-operative navigation.

Together with Holomedicine, which is a mixed reality (MR) based technology, this represents a significant leap forward in the surgeons’ ability to predict how organs will behave during a surgery, and predict how internal structures will move and change as the surgery is being performed.

“Holomedicine leverages mixed reality to interact with virtual objects superimposed onto the real world, allowing for unparalleled accuracy in pre-surgical planning,” explained Dr Gao, who will be presenting his work in mixed reality technology at the NUHS Scientific & Innovation Summit.

With this near-pinpoint precision, surgeons can minimise the risk of injuring other structures, thereby reducing potential complications and operating time, ultimately improving the patient’s overall recovery outcomes.

**Tackling diseases with precision**

Dr Anand Jeyasekharan, a senior consultant at the Department of Haematology-Oncology in the National University Cancer Institute, Singapore (NCIS), likens the human body’s reaction to cancer cells, to an intense battle between two warring armies.

It was a battle that became personal in 2023 for Mr Soegianto Nagaria, Dr Jeyasekharan’s patient. He had a large tumour in his liver excised by surgeons in Taiwan. Initially thought to be liver cancer, the reports indicated it to be a Stage 4 diffuse large B-cell lymphoma instead. The situation worsened when the doctors discovered the presence of a second lymphoma in his bone marrow.

Diagnosing and treating two concurrent cancers presented significant challenges, requiring precise and coordinated medical intervention. It was important to know if the two cancers were related, as the treatment would be very different if they were.

Upon recommendations by his cousins, who are doctors, Mr Nagaria decided to continue the rest of his treatment at NCIS, under Dr Jeyasekharan’s care.

Mr Nagaria flew to Singapore in September 2023, and underwent a molecular profiling under an NUHS programme for precision oncology (IMAC - integrated molecular analysis of cancer) to get his tumour sequenced. Following the sequencing, the NCIS team discovered that the two lymphomas were not related and drew up the vital treatment plans, providing life-saving ammunition in the cancer battle.

Mr Nagaria completed multiple rounds of chemotherapy over six months, and is now on close monitoring while in remission.

Besides sequencing, which Mr Nagaria underwent, Dr Jeyasekharan is developing a new tool in his arsenal of weapons against deadly cancers – spatial phenotyping,
where advanced imaging equipment is used to analyse cancer with high molecular detail.

Spatial phenotyping represents the next frontier of cancer research, and is especially useful for solid tumours. "We are trying to draw [battle] maps of cancer at a high resolution and in great detail, in order to understand how to fight it," Dr Jeyasekharan explained. “Spatial phenotyping’s ability to dive deep into molecular detail allows us to be more precise in diagnostics, treatment and care.”

With cancer being a leading cause of death globally, spatial phenotyping can mean a world of difference for patients afflicted with cancer. “We are never happy with just delivering standard treatment, because standard treatment simply isn’t good enough,” Dr Jeyasekharan said. “Some people get cured, some people don’t – we are trying to understand what we can do to improve the chances of curing more people.”

For A/Prof Su Xinyi, who is a senior consultant with the Department of Ophthalmology at NUH, precision medicine may be the key to restoring the vision of patients suffering from currently untreatable and blinding retinal diseases. “Every patient with retinal disease has a unique gene mutation, so the treatment that we provide is tailored specifically to the mutations that they have," A/Prof Su explained.

Besides gene therapy, A/Prof Su also explores innovations in cell therapy, which are last options for patients with end-stage age-related macular degeneration (AMD) – the third leading cause of blindness globally. In AMD, retinal pigment epithelium (RPE) cells in the retina degenerate with age. By growing these cells in a petri dish, and then injecting them into the eye, they can replace lost cells and help patients regain vision.

While this method of treatment is not new, what makes it unique is the source of cells A/Prof Su uses in its development – cells derived from the umbilical cord. By doing so, this greatly reduces the chance of rejection or the need to use immunosuppressants.

**Predicting risk factors, a step ahead**

Predictive care affords patients and clinicians the precious gift of time, in preventing the onset, or minimising the severity, of diseases. For Dr Jocelyn Chew, who is an assistant professor at the NUS Alice Lee Centre for Nursing Studies and Yong Loo Lin School of Medicine (NUS Medicine), adopting a predictive approach to tackling a person’s dietary triggers can curb overeating and obesity.

Dr Chew has been working on an app called the Eating Trigger-Response Inhibition Program (eTRIP), which is designed to help patients identify moments where they are prone to overeating. These include emotional eating, or even ingrained habits such as over-ordering during family gatherings.

eTRIP will be used in tandem with Adipoview, an AI-based dashboard that Dr Chew has created with the team from the NUHS Group Chief Technology Office. Adipoview will gather patient data throughout NUHS to generate insights, such as the diagnosis rate of obesity and treatment rate, to proactively predict who may need further support.
At the summit of innovation

More than 60 clinician-scientists will be presenting their work at the NUHS Scientific & Innovation Summit, which will be graced by guest-of-honour Professor Tan Chorh Chuan, Permanent Secretary for National Research and Development as well as for Public Sector Science and Technology Policy and Plans Office, Prime Minister’s Office.

Themed “Tomorrow’s Health Today – Predictive, Precise and Personalised”, the summit will bring together over 500 international and local healthcare experts, opinion leaders and scientists to shape the future of healthcare.

Over the past decade, the NUHS academic health system has secured more than $1 billion in competitive grants (cumulative from FY2011 to FY2021). These funds have fuelled scientific innovations in predictive, precise and personalised care, ensuring improved health outcomes for patients now and in the future.

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Chinese glossary

| National University Health System (NUHS) | 国立大学医学组织 |
| NUHS Scientific and Innovation Summit | 国立大学医学组织科学与创新研讨会 |
| National University Hospital | 国立大学医院 |
| Assistant Professor Anand Devaprasath Jeyasekharan | Anand Devaprasath Jeyasekharan 助理教授 |
| Senior Consultant | 血液肿瘤科高级顾问医生 |
| Department of Haematology-Oncology National University Cancer Institute | 新加坡国立大学癌症中心 |
| Associate Professor Su Xinyi | 苏心怡副教授 |
| Senior Consultant | 眼科高级顾问医生 |
| Department of Ophthalmology National University Hospital | 国立大学医院 |
| Dr Daniel Huang | 黄庆耀医生 |
| Consultant | 肠胃与肝脏科顾问医生 |
| Division of Gastroenterology and Hepatology Department of Medicine National University Hospital | 国立大学医院 |
| Dr Gao Yujia | 高羽嘉医生 |
| Consultant | 肝胆胰外科顾问医生 |
| National University Hospital | 国立大学医院 |
About National University Health System

The National University Health System (NUHS) is an integrated Academic Health System and Regional Health System in Singapore that delivers value-driven, innovative, and sustainable healthcare.

As Singapore’s only academic health system, we are uniquely positioned to draw on the academic, research and creative capabilities residing within the National University of Singapore (NUS). This collaboration allows us to develop solutions for existing and emerging health and healthcare needs of the Singapore population.

We also work in close collaboration with community hospitals, general practitioners, family medicine clinics, nursing homes and other community and social partners to provide integrated care to the wider community.

With member institutions ranging from community hospitals to academic centres, NUHS creates synergies as a fully integrated cluster to provide seamless care, develop solutions for Singapore’s healthcare challenges and nurture the next generation of healthcare professionals.