

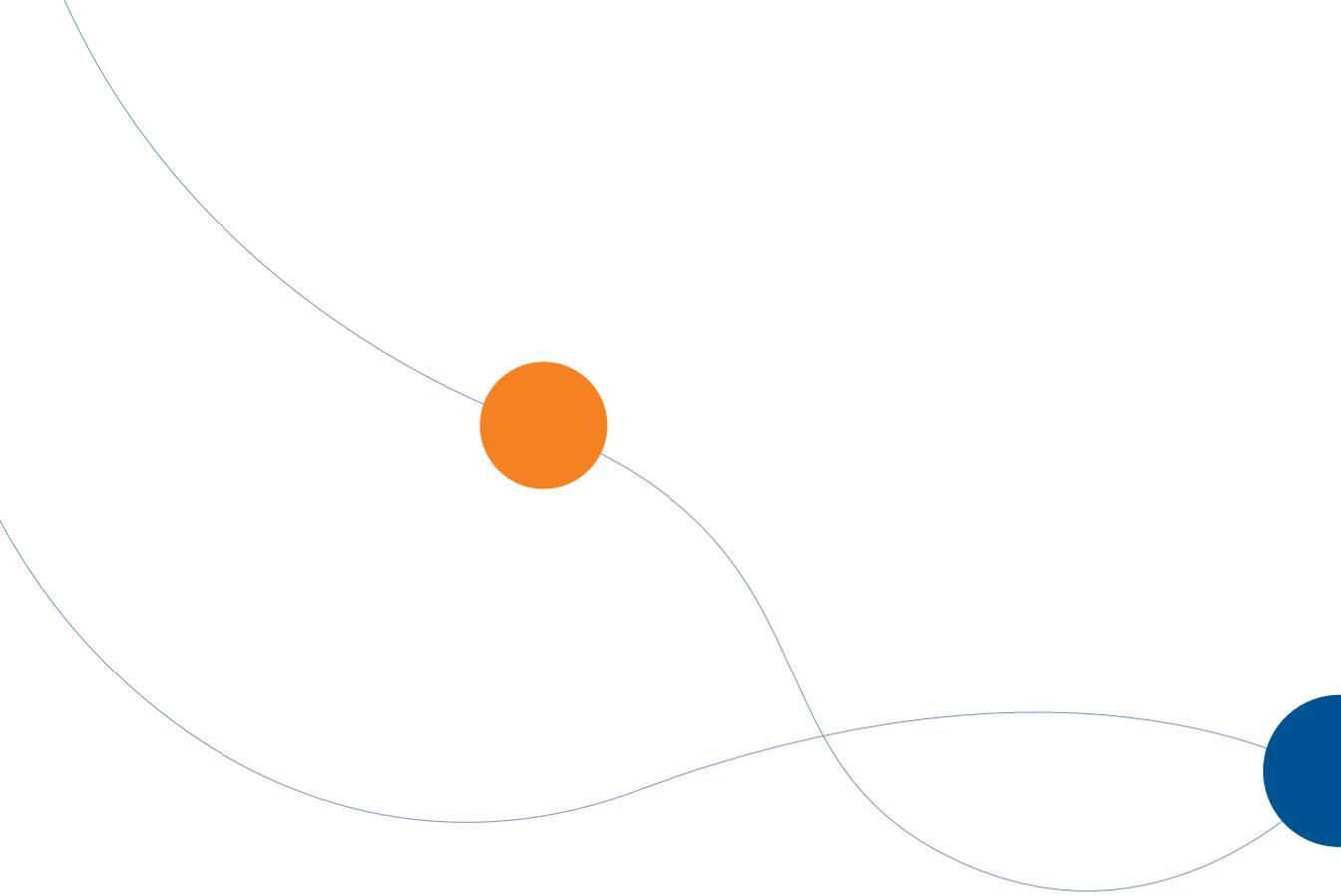


**Transforming
Medicine,
Improving
Lives**

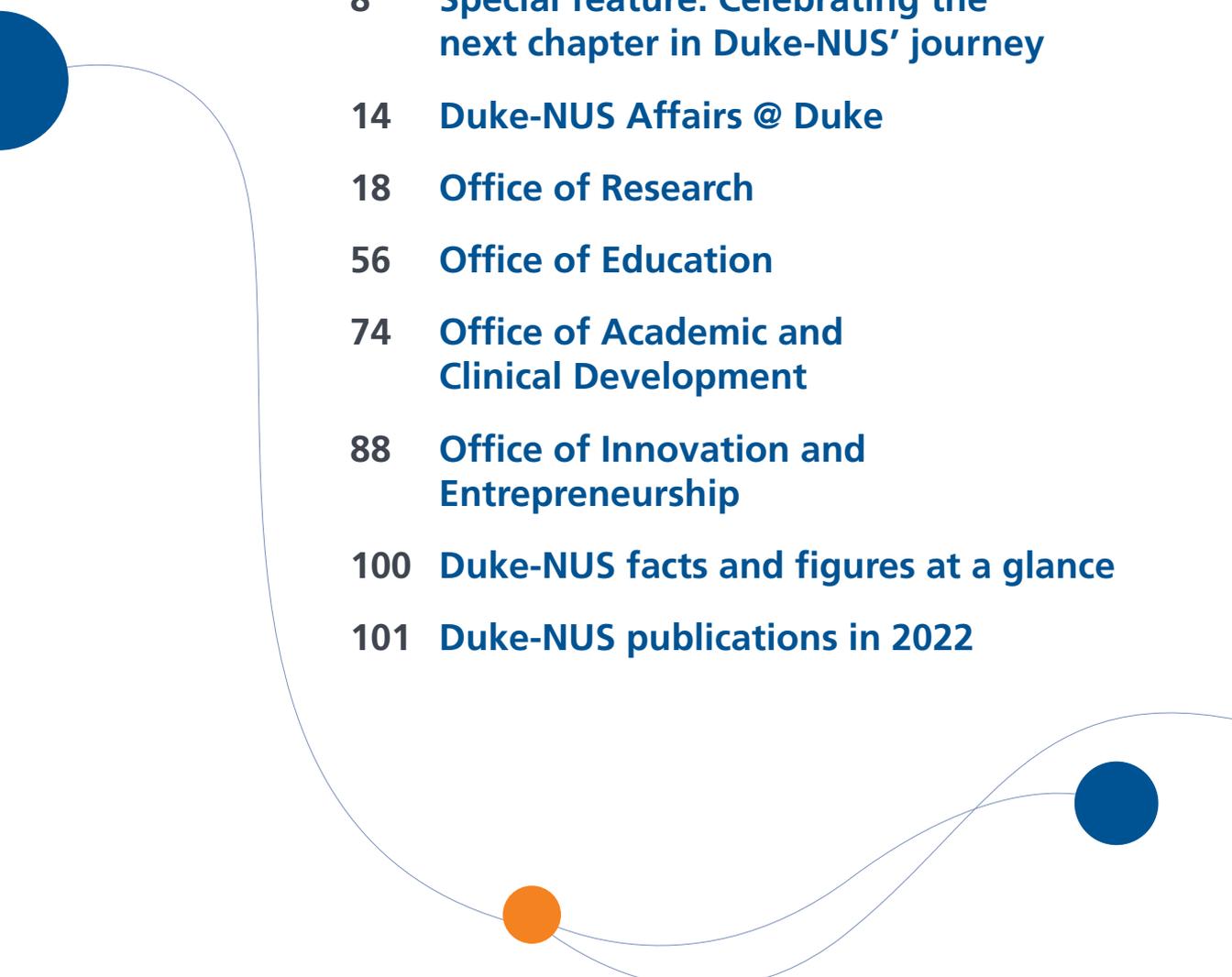


DukeNUS
Medical School

Annual Review 2022



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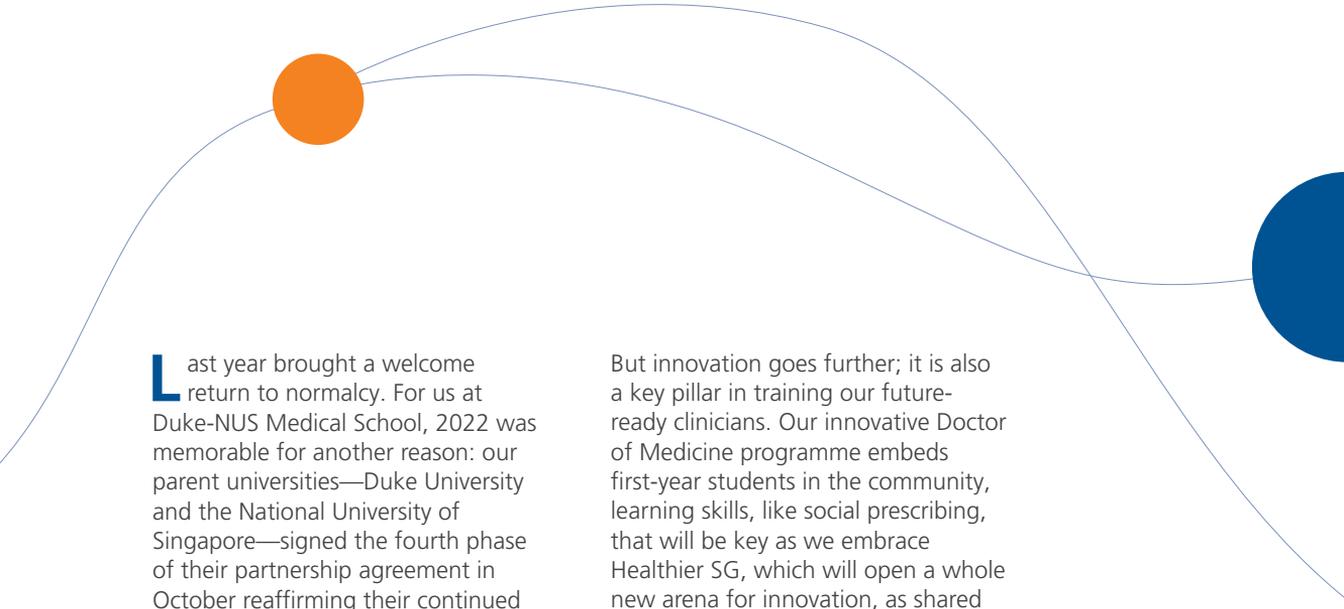
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Pressing on with innovation to shape a better future



Mr Goh Yew Lin
Chairman
Governing Board
Duke-NUS Medical School



Last year brought a welcome return to normalcy. For us at Duke-NUS Medical School, 2022 was memorable for another reason: our parent universities—Duke University and the National University of Singapore—signed the fourth phase of their partnership agreement in October reaffirming their continued commitment to Duke-NUS.

Born from this strategic partnership, Duke-NUS has collaboration imprinted in its DNA, making it natural for us to work with local and international partners to address the most pressing biomedical and healthcare needs in Asia, inspire future generations of clinician-scientists, and turn discoveries into innovations—all supporting Singapore's aspiration of becoming the region's biomedical hub.

In the span of less than 20 years, we have impacted real-world patient care by translating discoveries into more than 40 licenses completed and 22 active start-up companies, as of March 2023.

From advancing cutting-edge inventions and exploring the use of Artificial Intelligence and imaging systems in bedside applications to inventing clinical products to combat diseases including COVID-19, I am excited by the breadth and depth of the research conducted at our School.

But innovation goes further; it is also a key pillar in training our future-ready clinicians. Our innovative Doctor of Medicine programme embeds first-year students in the community, learning skills, like social prescribing, that will be key as we embrace Healthier SG, which will open a whole new arena for innovation, as shared by Health Minister Ong Ye Kung in an interview with Duke-NUS magazine, *MEDICUS*. And programmes like the Duke-NUS Health Innovator Programme launched last year will spark an innovation mindset in our students right from their school years.

To extend this innovation-conducive ecosystem, we, together with our academic medicine partner SingHealth, have also created a Discovery District on the campus to accelerate bench-to-bedside research. I am glad to learn that a number of biomedical companies have chosen our campus for their innovation centres, including Johnson & Johnson.

As we embark on the next chapter of our journey, I would like to thank our partners for collaborating with us and our donors for their generosity and trust. Together, we can realise impactful discoveries, develop peaks of excellence in medical education, research and innovation, and contribute to Singapore's future by continuing to transform medicine and improve lives.

Celebrating our people, collaborations and innovation



Professor Thomas M Coffman
Dean
Duke-NUS Medical School



At Duke-NUS, 2022 was a year that offered us many reasons to celebrate. As life returned toward normal, families and friends finally joined us again in person for the Class of 2022 graduation ceremony. We strengthened partnerships that had waned during the pandemic and continued to move innovations and discoveries from the bench to the bedside, benefitting patients.

One major cause for celebration this year was the initiation of Phase IV of the collaboration between Duke University and the National University of Singapore, signalling the beginning of another five years of this successful partnership. At the same time, we celebrated two individuals who played key roles in the early years of the School: our former Dean Ranga Krishnan and Emeritus Professor Duane Gubler who were both presented Honorary Citizen Awards—Singapore’s top honour for foreigners—in recognition of their valuable contributions to the country.

While the shadows of the pandemic are receding, research on the SARS-CoV-2 virus continues, along with preparation for Disease X. Our scientists are rapidly moving forward toward developing new coronavirus vaccines. To strengthen our ability to respond effectively to future outbreaks, we have worked with partners in Singapore and the region to launch the Centre for Outbreak Preparedness, aiming to enhance regional research capacity and cooperation for monitoring future health threats.

Together with our academic medicine partner, SingHealth, we continued to grow and enhance our Academic Medical Centre and support the

government’s vision of a healthier nation. We are doing this through collaborative population health research and by providing our medical students with skills and training that will be required in this new era. For example, we have introduced a module on social prescribing into the first-year curriculum of our MD programme to train students to connect patients with resources in the community to improve their health and lifestyles.

Beyond innovative initiatives in education, including our new Health Innovator Programme, we also made significant progress in research, bringing new hope to patients with groundbreaking discoveries from regenerating injured kidneys to innovative screening methods for cancers.

These remarkable efforts have, once again, placed our researchers among the world’s top scientists. Within the SingHealth Duke-NUS Academic Medical Centre, our budding clinician-scientists and innovators celebrated a bumper year, successfully securing Transition and first-time Clinician-Scientist awards through the National Medical Research Council’s Human Capital Awards and Talent Pipeline Programmes.

As you browse this Annual Review, I would like to invite you to join us in celebrating the strong community and collaborations that have enabled us to stay true to our vision of transforming medicine and improving lives — accomplishments that would not have been possible without the unstinting support of our people, partners and donors.

Together, let’s set the stage for another impactful year in medical education, research and innovation!

Governing Board

Chairman:

MR GOH YEW LIN
Managing Director
G.K. Goh Holdings Ltd

Deputy Chairman:

PROFESSOR HO TECK HUA
(till 31 March 2023)
Senior Deputy President
and Provost
National University of Singapore

Members:

DR FIDAH ALSAGOFF
Senior Managing Director
Joint Head, Enterprise
Development Group
Head, Life Sciences
Temasek International Pte Ltd

**PROFESSOR EDWARD
G BUCKLEY**
Vice-Dean for Education
Chair, Department of Ophthalmology
Duke University School of Medicine

MR CHNG HAK-PENG
Board Member
National Library Board Singapore

**PROFESSOR FONG
KOK YONG**
Deputy Group Chief Executive
Officer (Medical and Clinical
Services)
Singapore Health Services

DR GEH MIN
Immediate Past President,
Nature Society (Singapore)
Former Nominated Member
of Parliament

MR LEE KIM SHIN
Counsel
Allen & Gledhill LLP

MR LEE MING SAN
Managing Director
One North Capital Pte Ltd

MS LEE SZE YENG
Deputy Managing Partner
KPMG Singapore

MR MAK LYE MUN
Executive Chairman
Intraco Limited

**PROFESSOR KENNETH
MAK SECK WAI**
Director-General of Health,
Ministry of Health

MS JOAN MOH JIEHUI
Divisional Director, Higher
Education (Planning, Skills and
Academic Research)
Ministry of Education

**PROFESSOR IVY NG
SWEE LIAN**
Group Chief Executive Officer,
Singapore Health Services

MS TEO SWEE LIAN
Non-Executive and
Independent Director
Singapore Telecommunications Ltd

**PROFESSOR A EUGENE
WASHINGTON**
(till 30 June 2023)
Chancellor for Health Affairs
Duke University
President and
Chief Executive Officer
Duke University Health System



Attending the Governing Board retreat 2022 are:

Seated (L-R):

Dr Geh Min, Ms Lee Sze Yeng, Mr Goh Yew Lin, Professor Ivy Ng, Ms Teo Swee Lian.

Standing (L-R):

Mr Chng Hak-Peng, Ms Joan Moh, Professor Fong Kok Yong, Mr Mak Lye Mun, Mr Lee Ming San, Professor Ho Teck Hua, Professor Eugene Washington, Mr Lee Kim Shin, Professor Edward Buckley, Professor Kenneth Mak, Dr Fidah Alsagoff.

Special feature: Celebrating the next chapter in Duke-NUS' journey

Since its inception in 2005, Duke-NUS has remained steadfast in its mission of transforming Singapore's healthcare landscape by nurturing a pipeline of clinician-scientists and expert clinicians who are poised to take on leadership roles in the healthcare and biomedical sciences ecosystem.

Duke-NUS' focus on academic medicine to translate cutting-edge research discoveries into real-world healthcare solutions has made the

School a key player in the nation's dynamic biomedical ecosystem, contributing to Singapore's vision of being the biomedical hub of Asia.

The School's ability to punch well above its weight was confirmed by our parent universities when they officially signed the fourth phase agreement at Duke University's Allen Building in Durham, USA, on 13 October 2022, reaffirming their commitment to the Duke-NUS partnership.



(L-R) The agreement for Duke-NUS' fourth phase of funding was signed by Professor Vincent Price, Duke University President; Professor Tan Eng Chye, NUS President; Professor Eugene Washington, Chancellor for Health Affairs of Duke University; and acknowledged and supported by Mr Goh Yew Lin, Duke-NUS Governing Board Chairman.



I am fairly confident that it [Duke-NUS] will do well for Phase IV and I'm fairly confident that we will have a Phase V and I think we have ourselves a very good partner in Duke University."

Mr Ong Ye Kung
Minister for Health



(L-R) Professor Tan Eng Chye, Professor Vincent Price, Mr Goh Yew Lin and Professor Eugene Washington in front of the Duke University Chapel after the Phase IV agreement signing ceremony on 13 October 2022.



Duke-NUS has been one of Duke's most successful global ventures, bringing together the best in medical education, translational and innovation from two world-leading universities. The partnership has enriched the Duke community and broadened our expertise through the exchange of faculty and students, knowledge, and local insights. I am particularly proud of the Duke/Duke-NUS Research Collaboration Pilot Project Grant, which further strengthens ties between our two institutions with continuous collaborations between Durham and Singapore researchers to advance translational and clinical research."

Professor Vincent Price
Duke University President



Duke-NUS has distinguished itself as an innovative education and research powerhouse that develops high-potential individuals to become not just exemplary clinicians but also capable researchers and critical thinkers. As the School moves into its next phase with renewed commitment, Duke-NUS, through its unique 'Clinicians First, Clinicians Plus' pedagogy and highly interactive flipped-classroom educational philosophy, is well positioned to be part of NUS' strategic priority to offer multidisciplinary educational pathways and support Singapore's aspirations for a healthier nation and develop an ecosystem of support for better health for all Singaporeans."

Professor Tan Eng Chye
NUS President

Double the celebration, double the joy

Following the signing of the fourth phase of the Duke-NUS partnership agreement in October, our stakeholders gathered in Singapore on 21 November 2022 to celebrate this latest milestone.

The event was graced by Singapore's Education Minister, Mr Chan Chun Sing, and Health Minister, Mr Ong Ye Kung, as Guests-of-Honour. They were joined by Prof Tan Eng Chye, members of the Duke-NUS Governing Board as well as distinguished guests from the Ministries of Education and Health, Duke-NUS' academic medicine partner, SingHealth, and members of the Duke-NUS community.



(L-R) Professor Ivy Ng, SingHealth Group CEO; Professor Tan Eng Chye; Minister Chan Chun Sing; Mr Goh Yew Lin; Minister Ong Ye Kung; Professor Thomas Coffman, Duke-NUS Dean; and Mr Tony Chew, Duke-NUS' Governing Board Founding Chairman.



Minister for Health, Mr Ong Ye Kung, and Minister for Education, Mr Chan Chun Sing, are briefed on the School's innovation efforts.



The ideal partnership is one where each party brings value to the other, and I think this win-win philosophy very much underpins the success of Duke-NUS. This partnership between universities is significantly enhanced by Duke-NUS' symbiotic, mutually enhancing relationship with SingHealth in the Academic Medical Centre and in many other ways, which goes from strength to strength."

Mr Goh Yew Lin
Duke-NUS Governing Board Chairman



You take what is still the smallest medical school in Singapore and the largest public healthcare cluster. And you put them together and intuitively, you might not think it's a good marriage, but it's a wonderful one that has produced many things."

Professor Ivy Ng
SingHealth Group CEO



As we take this pause to think about our history and future, we can really celebrate the success of this Duke-NUS project, taking pride in the fact that a small, research-intensive, American-style, graduate-entry medical school can thrive here in Singapore and add significant value to medical education, to research, to academic medicine both here and globally."

Professor Thomas Coffman
Duke-NUS Dean



*Watch the highlight
video of the event here.*



Minister for Health, Mr Ong Ye Kung, and Minister for Education, Mr Chan Chun Sing, visit the 3D printing booth at the milestone celebration.

Duke-NUS' secret to success

Central to Duke-NUS' success is the School's emphasis on the value of collaboration. Over the years, the School has forged many valuable partnerships and close ties with institutions and agencies in Singapore and beyond, including Nanyang Technological University, Singapore, A*STAR and Temasek.

In particular, the Duke-NUS and SingHealth partnership has enabled both parties to leverage their joint

capabilities, infrastructure and resources to generate returns that are bigger than the sum of its parts.

As the School embarks on its fourth chapter, it continues to focus on the core pillars that the School is built on, through combining education with cutting-edge research and innovation.

"That has always been something special about the medical faculty, and I think it is that essence that makes Duke-NUS special," said Health Minister, Mr Ong Ye Kung.

Duke-NUS Affairs @ Duke

Representing Duke-NUS on the Duke University campus in Durham, North Carolina, the Office of Duke-NUS Affairs acts as the focal point for collaborative initiatives between Duke, Duke-NUS and SingHealth. It functions as a single portal of entry for access to Duke and supports exchange programmes between institutions, with the aim of impacting community health and expanding the growth of academic medicine at Duke and Duke-NUS.





The year 2022 has been an exciting and productive year for Duke and Duke-NUS collaborations. In October, we signed the Phase IV agreement assuring another five years of funding for the School and its missions. The Duke and NUS partnership continues to leverage the strengths of both institutions to advance medical research, education, and healthcare in Singapore and Southeast Asia.

Over the last 18 years, we have witnessed the maturation of a true academic medical centre (AMC) in Singapore through engagement with Duke and Duke-NUS faculty to the extent that partnership opportunities are now available in areas such as pandemic preparedness, global health, neuroscience, ageing and others, and they span from basic to translational to clinical research and education.

This Fall, the Duke-NUS academic committee made up of leaders in education from both schools—the Duke School of Medicine and Duke-NUS—met in Singapore to continue shaping the Duke-NUS curriculum to nurture a pipeline of academic clinicians. Our early graduates are finishing their training and taking up leadership positions at Duke-NUS. In parallel, the SingHealth and Duke-NUS leadership teams continue to support the advancement of the AMC model which has led to success in the form of centre grants, training of clinician researchers and clinician-scientists.

The academic clinical programmes, through engagement with Duke faculty and clinical departments, have created a culture that values research and training of clinicians—something that would not have been possible without Duke's committed engagement with Duke-NUS and SingHealth over the last 15 years.

Over in Durham, North Carolina, I see the Office of Duke-NUS Affairs as the conduit between Duke University and Duke-NUS to support partnerships in research, education and clinical collaboration. Besides managing the flow of information between Durham and Singapore and administratively supporting collaborative projects, the Office facilitates and promotes engagement in the form of symposia, workshops, retreats and conferences and supports exchange programmes at both sites, while streamlining processes to foster and catalyse collaboration. Ultimately, this will enhance the visibility of Duke-NUS in Durham and Duke in Singapore, and that, in turn, will drive greater synergy between both institutions.

By prioritising research collaborations, education and training, as well as nurturing public-private partnerships, addressing healthcare disparities, and embracing emerging technologies, we hope to continue making a positive impact on healthcare in Singapore and at Duke."

Professor Edward Buckley,
Vice-Dean for Education,
Vice-Chancellor for Duke-NUS Affairs
Member, Duke-NUS' Governing Board

Duke/Duke-NUS research collaboration awards

Duke and Duke-NUS offer a series of collaborative research grants, including the Duke/Duke-NUS Research Collaboration Pilot Project Grant. The goal of these grants is to nurture international research collaborations between faculty in Durham, North Carolina, and Singapore to advance translational and clinical research, including research on medical technologies.

2022 recipients for Duke/Duke-NUS Research Collaboration Pilot Project Grant

Duke University Principal Investigator	Duke University Department	Duke-NUS Principal Investigator
Assistant Professor Michael Tadross	Biomedical Engineering	Associate Professor Adam Claridge-Chang
Associate Professor Ayako Suzuki	Gastroenterology and Hepatology	Assistant Professor Brijesh Kumar Singh
Assistant Professor Zhang Guofang	Medicine	Assistant Professor Ching Jianhong
Professor Nancy Zucker	Psychiatry and Behavioural Science	Clinical Assistant Professor Courtney Elizabeth Griffiths Davis
Professor Christopher Newgard	Duke Molecular Physiology Institute	Associate Professor Jens Marc Titze
Assistant Professor Hong Chuan	Biostatistics and Bioinformatics	Associate Professor Liu Nan
Assistant Professor Chen Yong	Neurology	Clinical Assistant Professor Lim Su Ping, Regina
Professor Timothy Strauman	Psychology and Neuroscience	Assistant Professor Sharon Cohan Sung
Assistant Professor Amanda Randles	Biomedical Engineering	Associate Professor Zhong Liang
Assistant Professor Laurie Sanders	Neurology and Pathology	Assistant Professor Zhou Zhi Dong

Duke/Duke-NUS education collaborations

Advancing medical education is one of the cornerstones of the Duke-NUS/Duke Durham collaboration.

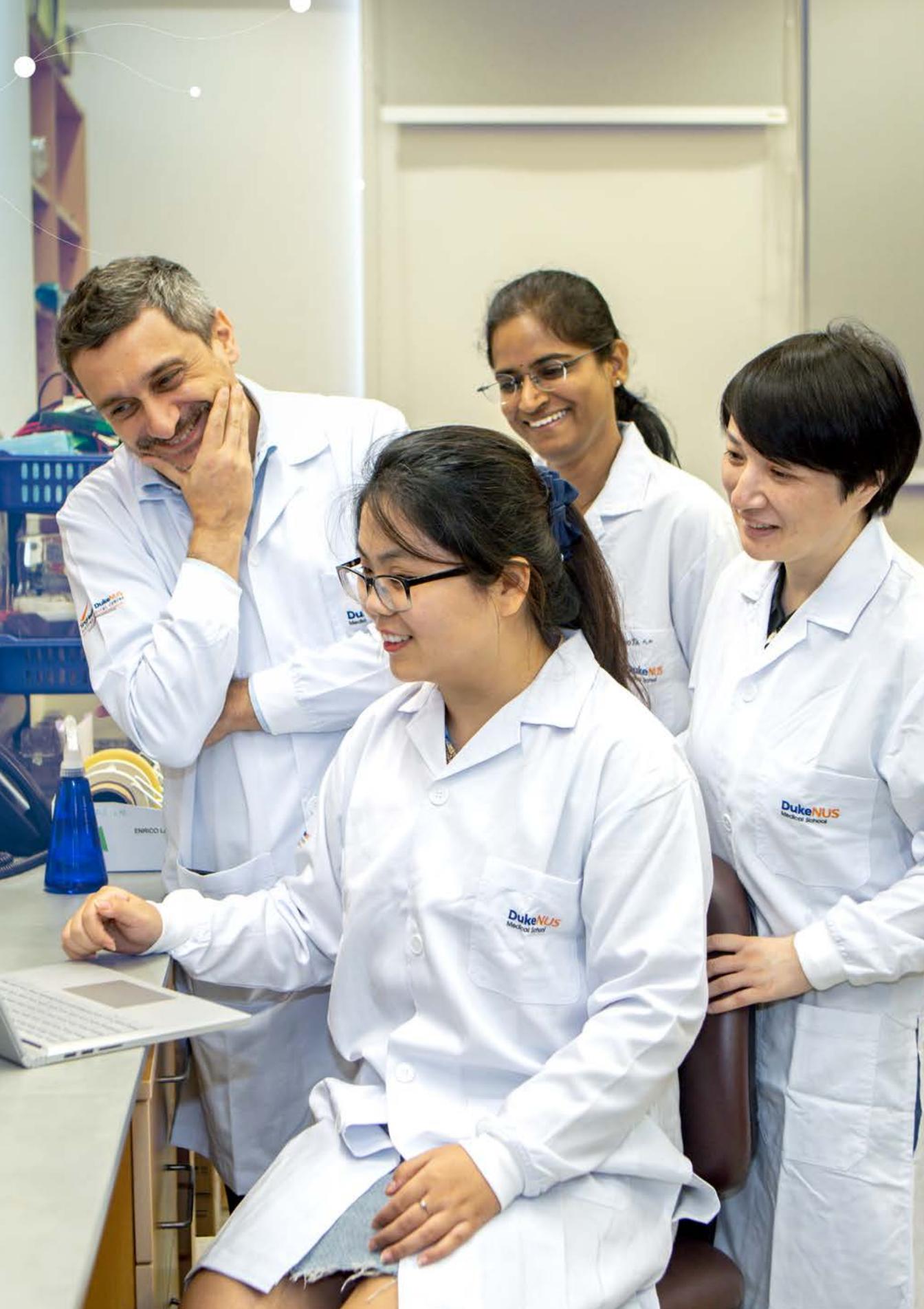
Part of this collaboration includes exchange programmes that enable medical students to carry out dedicated research projects at Duke-Durham and Duke-NUS by supporting students through scholarships. These exchanges provide unique experiences that influence the research and academic career trajectories of medical students at both institutions, while fostering long lasting and synergistic collaborations between labs.

Duke-NUS Programme	Project Title
Neuroscience and Behavioural Disorders Programme	Cell-tethered drugs in a small-animal model to analyse circuit function
Cardiovascular and Metabolic Disorders Programme	Roles of sex and age on the efficacy of homocysteine-lowering supplements to treat nafld
Cardiovascular and Metabolic Disorders Programme	Dysregulated fatty acid metabolism leads to kidney disease in propionic acidaemia
Paediatrics Academic Clinical Programme; KK Women's and Children's Hospital	Adapting the us-based parental skill training model of adolescent eating disorder treatment into an innovative culturally relevant digital treatment model in singapore
Cardiovascular and Metabolic Disorders Programme	Role of branched-chain amino acid metabolism in the pathogenesis of salt-induced left ventricular hypertrophy
Centre for Quantitative Medicine	Privacy-preserving, adaptive federated and swarm learning: emergency department triage decision-making across two international healthcare systems
Medicine Academic Clinical Programme; Changi General Hospital	Targeting skin trpv4 to alleviate psoriatic itch
Health Services and Systems Research Programme	International collaborative study of a telehealth stepped-care intervention for ed patients with panic-related anxiety
Cardiovascular Sciences Academic Clinical Programme; National Heart Centre Singapore	Improved detection of Ischaemia-induced coronary stenosis with a novel parallel computational fluid dynamic solver
Neuroscience and Behavioural Disorders Programme; National Neuroscience Institute	Identification of binding partners of homopolymeric polyglycine protein as new therapeutic targets of non-coding CGG repeat expansion induced neurodegeneration

OFFICE OF RESEARCH

Pushing the boundaries of innovation





// When people from different backgrounds come together, there are always new ideas that you've not thought about. We discover new ways of solving a problem. **//**

Assistant Professor Lena Ho
Cardiovascular and Metabolic
Disorders Programme



Lifting veil on the hidden world of microproteins

Small but mighty—that is how Assistant Professor Lena Ho from the Cardiovascular and Metabolic Disorders Programme describes microproteins, a class of tiny molecules that enable our cells to extract energy from nutrients.

“They are very, very small and have been, for a long time, overlooked by traditional scientific methods used to study proteins and genes,” she said. So overlooked that when she first embarked on her work, she was among only a handful of scientists around the world investigating their function.

In her quest to uncover the fundamental mechanisms of these microproteins, Asst Prof Ho teamed up with researchers from Duke University in the USA and the University of Melbourne in Australia to investigate these microproteins.

Their work, which is supported by the Duke/Duke-NUS Research Collaboration Pilot Project Grant has revealed details of the crucial role these microproteins play in assembling larger protein complexes inside energy-generating cell components known as mitochondria.

“By studying these microproteins and understanding how to target their activity to treat mitochondrial diseases, we are really increasing our knowledge of genetics, possibly enabling us to solve what causes a particular disease,” explained Asst Prof Ho.

In 2022, a study found about 1 in 5,000 people worldwide is affected by mitochondrial diseases such as heart failure, diabetes, cancer, and sepsis—an extreme, and sometimes fatal, response to an infection.

And translational research, like Asst Prof Ho’s microprotein work, is the linchpin in novel inventions that address the underlying drivers of these diseases.

“One possible translational value of this protein that we found is its role in helping us control the inflammation associated with sepsis,” she explained.

To accelerate bench-to-bedside translations, Asst Prof Ho had to establish a foothold in the global biotech ecosystem. Benefitting from Singapore’s reputation in biomedical research and Duke-NUS’ strong global network, Asst Prof Ho had access to a wide pool of valuable patient cohorts, cutting-edge technology and critical technical resources, which helped her lab “focus very intensely on high-output methods and smarter ways” of doing things.

“From a scientific point of view, we have really gotten a lot better and faster at trying to understand what these proteins do,” she said. “We are talking about substantially increasing the known number of microproteins by as much as 30 per cent. That’s a large repository, offering huge therapeutic potential for mitochondrial diseases.”

Likening Duke-NUS to microproteins, Asst Prof Ho said, “It’s very easy to think that we [at Duke-NUS] are the smaller cousin, compared to Duke or Melbourne. But when I started interacting more with their faculty, I realised that they are extremely interested in what we do here. They think very highly of the quality of the school.”

Cancer and Stem Cell Biology Programme



Cancer and Stem Cell Biology (CSCB) scientists continue to make ground-breaking discoveries, and 2022 was no exception.

The studies led by Professors Patrick Tan, Steven Rozen, and Associate Professor Koji Itahana stand out as remarkable achievements that shed new light on the molecular pathways driving cancer growth, identify novel biomarkers for predicting treatment efficiency, and discover a previously undescribed oncogenic role for an enzyme regulating DNA topology and chromosome organisation. The identification of gene signatures that can predict treatment outcomes in natural-kill or T-cell lymphoma tumours represents a major breakthrough that could improve disease management and enhance patient outcomes.

The impact of CSCB's research in 2022 extends beyond the scientific community and into the wider society, providing hope for those who suffer from cancers and other complex diseases.

These accomplishments showcase the power of interdisciplinary collaboration and innovation. I have no doubt that the scientists and trainees of CSCB will continue to make ground-breaking discoveries in the coming years.



Professor David Virshup

Director
Cancer and Stem Cell Biology Signature
Research Programme

New insights into molecular pathways in gastric cancer

In a study published in *Cancer Discovery* in March 2022, Professor Patrick Tan and his team described the assembly of the largest and highest-resolution single-cell atlas of gastric cancers. The atlas provides novel insights into the molecular pathways driving gastric cancer growth and metastasis and the heterogeneity of tumours among patients. In a separate study published in *Gut* in April 2022, Prof Tan identified a gene signature representing the first predictive biomarker for patient survival in response to chemotherapy drug paclitaxel, based on data from a large, phase III clinical trial conducted in gastric cancer patients.



Professor Patrick Tan (centre, in pink shirt) and members from his lab.

A novel oncogenic role for hTOP2 α

Professor Steven Rozen revealed a novel oncogenic role for human topoisomerase II α (hTOP2 α), an enzyme regulating DNA topology and chromosome organisation. In the paper published in *Proceedings of the National Academy of Sciences* in January 2022, Prof Rozen linked a previously undescribed mutated phenotype in cancers with a somatic mutation in hTOP2 α , which causes genomic rearrangements and potentially oncogenic indel mutations in several cancer-driver genes. The findings could form the basis for the development of novel therapeutic strategies against cancers.

Novel biomarkers for selective targeting of cancer cells

A study led by Associate Professor Koji Itahana revealed a novel biomarker—the cysteine/glutamate antiporter xCT—for predicting cancer treatment efficiency. In the paper, which was published in the *Journal of Cell Science* in August 2022, the researchers also described a novel crosstalk between xCT and AMPK, a major regulator of metabolic homeostasis. The findings suggest the application of xCT as a potential biomarker to improve the selective targeting of cancer cells.

Better prediction of treatment outcomes for natural-killer/T-cell lymphoma tumour patients

In a joint study led by SingHealth Duke-NUS Academic Medicine Centre researchers, including Professors Patrick Tan, Teh Bin Tean, Steven Rozen, and Associate Professor Ong Choon Kiat, a set of 13 genes that can predict treatment outcomes in natural-killer/T-cell lymphoma tumours was identified through sequencing 260 tumour samples.

Published in the *American Journal of Hematology* in September 2022, the study reported that patients with poorer prognosis carry one or more of these gene mutations. This mutational gene signature could significantly improve current prognostic models that are solely based on clinical parameters and identify patients who are not responding well to chemo- and radiotherapy for better disease management.



My research focuses on gastric cancer and aims to explore the genomic and transcriptomic changes associated with intestinal metaplasia, a precursor lesion of gastric cancer. By collecting gastric biopsy samples from intestinal metaplasia patients and utilising cutting-edge genomic and transcriptomic technologies, we hope to identify key molecular changes that are associated with the emergence and progression of intestinal metaplasia.

Our research will help address the challenge of poor prognosis faced by gastric cancer patients who are oftentimes diagnosed with advanced-stage cancer when treatment options are limited. This is also relevant in the

context of Singapore where gastric cancer incidence is moderate but population screening is not cost-effective enough to allow early detection.

Thanks to the Khoo Postdoctoral Fellowship, which has been instrumental in supporting and enabling this research, I can focus on my work without worrying about financial constraints. In addition, the Fellowship has provided me with access to cutting-edge facilities and resources to conduct this research for a better understanding of the pathogenesis of gastric cancer and to guide precision prevention efforts.

Our work now involves analysing over 1,200 gastric biopsy samples, resulting in the identification of 25 new driver genes, including one called SOX9, which may promote intestinal metaplasia. In addition, using single-cell and spatial transcriptomic approaches, we could pinpoint a specific population of intestinal stem cells that appear to be the cell-of-origin for both intestinal metaplasia and gastric cancer.

The findings of this research suggest that using genomic information may help to identify intestinal metaplasia patients who are at higher risk of developing gastric cancer compared with models based solely on clinical data. Our immediate goal is to further test this hypothesis and validate the potential of using genomic information to improve risk stratification, ultimately leading to a more personalised clinical management for intestinal metaplasia patients who have different risk profiles of developing gastric cancer.



Dr Huang Kie Kyon

Senior Research Fellow, Khoo Postdoctoral Fellow

Cardiovascular and Metabolic Disorders Programme



Professor Wang Yibin

Director
Cardiovascular and Metabolic Disorders
Signature Research Programme



Having joined Duke-NUS as the Director of the Cardiovascular and Metabolic Disorders (CVMD) Signature Research Programme (SRP) in 2021, I am pleased to see the programme grow from strength to strength. We emerged from COVID with a number of new initiatives that restored academic interactions, strengthened research infrastructure, and advanced scientific impact and excellence.

Among these initiatives were an in-person programme-wide retreat for all faculty, research and admin staff; the establishment of a state-of-the-art cardiovascular physiology core; the resumption of the CVMD SRP seminar series; the launch of a nationwide Excellence in Cardiovascular Science Visiting Professorship; and a recruitment campaign for new tenure-track faculty members.

Thanks to the generous support of the Goh Foundation, CVMD and the National Heart Centre Singapore launched the Goh Cardiovascular Research Award to support high-risk, high-impact pilot research projects across the SingHealth Duke-NUS Academic Medical Centre ecosystem.

On the research front, CVMD investigators continued to make ground-breaking discoveries to address the most challenging unmet needs in cardiometabolic diseases, advancing knowledge in areas ranging from tissue-fibrosis to obesity, from diabetes to non-alcohol steatohepatitis, and from chronic kidney disease to heart failure, bringing real impact to people living with cardiovascular and metabolic disorders.



Targeting IL11 in a novel therapeutic approach against Alport syndrome



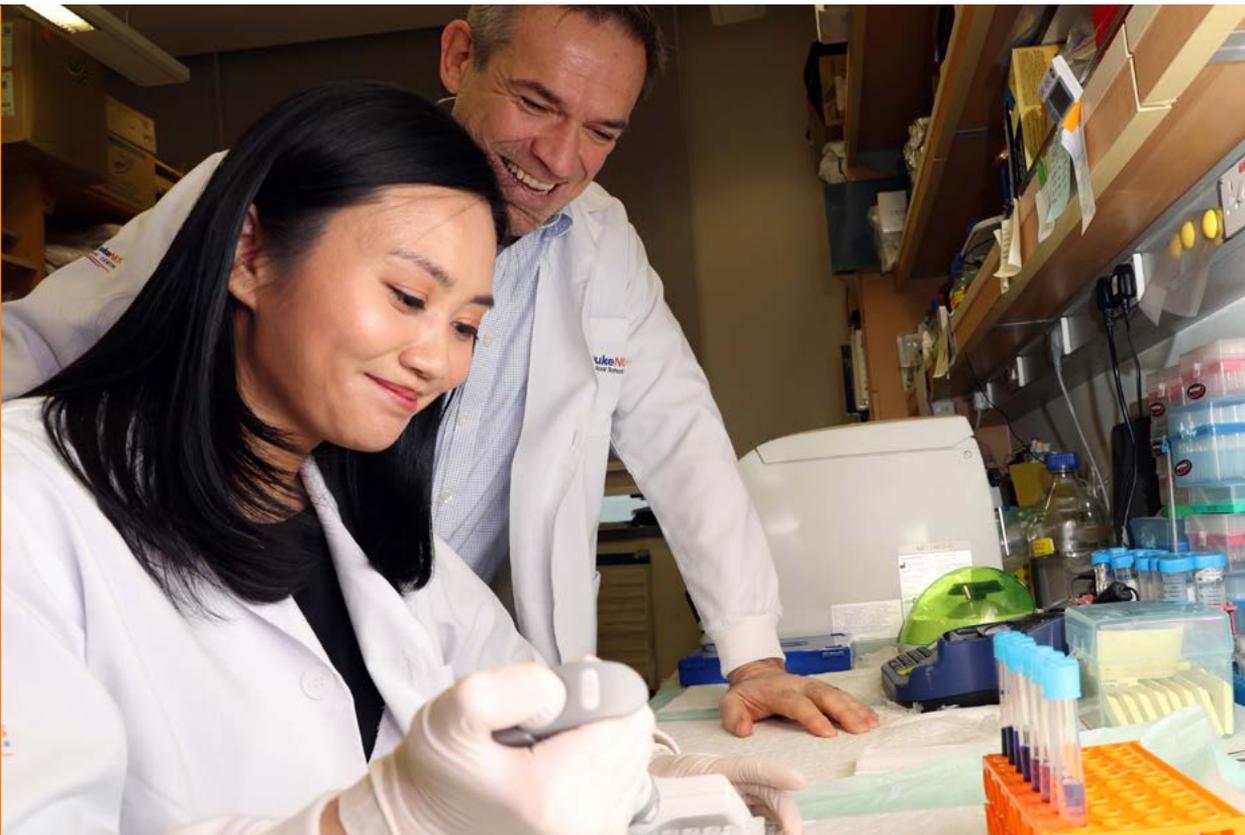
Watch the animation
to learn more about
this discovery.

A treatment strategy using an antibody that inhibits a cell-signalling protein called interleukin-11 (IL11) could lead to new hope for people with a debilitating genetic kidney disease called Alport syndrome, a study led by Tanoto Foundation Professor Stuart Cook and Assistant Professor Anissa Widjaja showed.

The findings, published in the *Journal of the American Society of Nephrology* in February 2022, showed that administration of anti-IL11 therapies, in the form of an antibody drug, reduced the severity of Alport syndrome and improved kidney function in preclinical models, by reducing kidney injury, inflammation and scarring.

Importantly, combining anti-IL11 therapies and angiotensin-converting enzyme inhibitors (ACEi), which is the current standard care for Alport syndrome patients, increased the lifespan of the experimental group by more than 400 per cent relative to those that were treated with ACEi alone.

Asst Prof Widjaja and her team are extending their research into investigating whether anti-IL11 therapies can reverse kidney failure by promoting tissue regeneration.



Assistant Professor Anissa Widjaja (left) and Tanoto Foundation Professor Stuart Cook lead work on anti-IL11 which will bring hope to millions of patients worldwide.

Photo source: The Lianhe Zaobao @ SPH Media Limited. Permission obtained for reproduction.

Singapore clinician-scientist part of team winning £30m in global British Heart Foundation challenge

An international team of researchers—including Tanoto Foundation Professor Stuart Cook—was awarded £30m (approximately S\$50m) to develop an injectable cure for genetic heart conditions that kill young people in the prime of their lives. The award is part of the British Heart Foundation's Big Beat Challenge and the largest in the charity's 60-year history.

The winning team, CureHeart, is composed of a group of scientists from the UK, US and Singapore, whose vision is to develop effective cures for inherited heart muscle diseases. Prof Cook's work in Singapore is particularly relevant given the differences in the genetic makeup between Asians and other ethnic groups and the impact of these differences on the prevalence and course of several cardiovascular disorders.

The team will pioneer ultra-precise gene therapy technologies that could silence or edit the faulty genes causing these deadly conditions. Specifically, they will explore the role of interleukin-11 (IL11), a cytokine that has been associated with pro-inflammatory responses, in genetic heart muscle disease using preclinical models, and develop antibody therapies targeting this protein. They will also identify new diagnostic and therapeutic targets for patients who are genetically predisposed to cardiovascular diseases, providing hope for families struck by these deadly diseases.



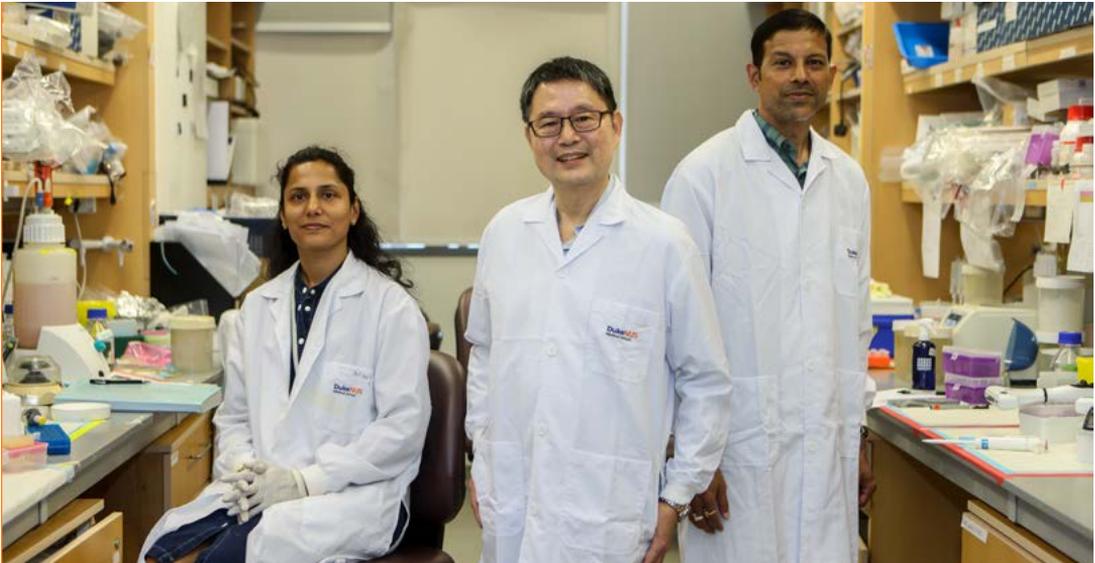
A spermidine intervention to treat advanced non-alcoholic fatty liver disease

In a study published in *Nature Communications* in September 2022, Professor Paul Yen and Senior Research Fellow Dr Zhou Jin identified that a molecular pathway that is essential for the hypusination of translation factor Eif5a is disrupted in non-alcoholic steatohepatitis (NASH) and can be treated with spermidine, a naturally occurring polyamine with anti-ageing properties, partially restoring mitochondrial function.

The research team highlighted how the effects of spermidine could reverse NASH pathogenesis and thus form the basis for the development of drugs against this major health condition.

Using B vitamins to treat advanced non-alcoholic fatty liver disease

In a separate study published in the *Journal of Hepatology* in November 2022, Professor Paul Yen, Senior Research Fellow Dr Madhulika Tripathi and Assistant Professor Brijesh Kumar Singh suggest that NASH pathogenesis could be reversed with vitamin B12 and folic acid supplementation, offering promise in the application of B12 and folic acid as first-line therapies for the prevention and treatment of NASH. This, in turn, could significantly reduce healthcare costs associated with the disease in both developed and developing countries.



(L-R): Senior Research Fellow Dr Madhulika Tripathi, Professor Paul Yen, and Assistant Professor Brijesh Kumar Singh.

New technique to reveal the hidden genome

Using an innovative methodology that combines RNA sequencing and ribosome profiling techniques, Research Fellow Dr Sonia Chothani and her collaborators from Singapore, Germany, the UK, and Australia identified thousands of previously unknown DNA sequences in the human genome that code for microproteins and peptides, potentially critical for human health and disease.

Published in *Molecular Cell* in August 2022, this new method can overcome some of the current limitations in identifying small open reading frames (smORFs) that can also be translated from RNA into small peptides, which have roles in DNA repair, muscle formation and genetic regulation.

Their analyses identified nearly 8,000 smORFs and 603 microproteins coded by some of these smORFs. The research could provide potential new targets for disease research and drug development that could open avenues to new solutions.

New understanding of the inner world of lysosomes

A multidisciplinary team of scientists, led by Professor David Silver, Deputy Director of the CVMD Programme, identified the protein responsible for transporting degraded membrane lipids out of lysosomes, cellular organelles that are the breakdown factories of cells.

Prof Silver and Ms Menglan He, MD-PhD candidate from the Integrated Biology and Medicine Programme and Dr Alvin Kuk, Postdoctoral Fellow with the CVMD Programme found that a protein called Spns1, which belongs to the major facilitator superfamily, transports the degradation products of two phospholipids, phosphatidylcholine and phosphatidylethanolamine, out of lysosomes and into the cytoplasm. The two phospholipids, which are important structural and functional building blocks of living cells, then go through pathways that recycle them into their original lipid forms so they can be reincorporated into the cell.

Published in the *Proceedings of the National Academy of Sciences*, the study provides crucial insights into the functions of this newly identified transporter protein and its relevance in health and disease.

Gene that controls scarring in damaged hearts

A study led by Associate Professor Enrico Petretto's team unravelled the role of the gene WWP2 in promoting fibrosis and scar tissue formation in the heart. The study, published in *Nature Communications*, showed that targeting this gene could delay scarring and progression to heart failure, and improve cardiac function.

The study specifically focused on the crosstalk between macrophages, immune cells that clear foreign material in the body, and fibroblasts, cells that produce scar tissue, in the early stages of fibrosis. When expressed in a specific type of cardiac macrophages, WWP2 promotes scarring by 'irritating' the fibroblasts to cause excessive scarring during the early phases of common heart diseases or cardiomyopathies. Blocking WWP2's function in this subset of cardiac macrophages is thus enough to slow—or even stop—the scarring.

The team is now developing small molecule inhibitors that target a specific form of the WWP2 protein, which has already shown promising anti-fibrotic results in cells, providing therapeutic potential for treating fibrotic conditions like non-ischaemic cardiomyopathies, and other fibrotic diseases where WWP2 is involved. Senior Research Fellow Dr Chen Huimei is the first and co-corresponding author of this paper.



Associate Professor Enrico Petretto (left), and Senior Research Fellow Dr Chen Huimei.



Running a lab independently as a young PI presents me with many rewarding opportunities to pursue my scientific ideas and mentor the next generation of scientists, although it comes with challenges.

One of the biggest challenges is securing funding—and for this, I am incredibly humbled and honoured to receive the Goh Cardiovascular Award. The invaluable support from Goh Foundation has enabled me, an early career researcher, to pursue innovative ideas that can make a positive impact and produce critical research outcomes in the cardiovascular disease field.

This award is a testament to the dedication and hard work of my team and I. Over the last few years, our team has focused on studying the effects of organ injury, inflammation, and scarring in the heart, liver and kidney, and how these problems cause diseases that are very common in Singapore and around the world. Going forward, we will focus our expertise on studying mechanisms and providing evidence using mouse models of disease for a practical therapy that can reverse organ failure and promote organ regeneration for patients' benefit.

To budding scientists who share the same passion and inspiration, my advice would be to stay curious and resilient in the face of obstacles—the most exciting discoveries often come to those who keep pushing the boundaries of what is known. Finally, don't forget to enjoy the journey—take pride in your success and celebrate your wins, even the small ones.

Assistant Professor Anissa Widjaja

Goh Cardiovascular Research Award recipient



Emerging Infectious Diseases Programme



In 2022, the Programme for Emerging Infectious Diseases (EID) continued to strive towards our mission of creating improved methods of detection, treatment, prevention and control of emerging pathogens. We continued to contribute to the understanding SARS-CoV-2 immunity, epidemiology and evolution, conducting fundamental and translational research that directly impacts vaccination strategies and vaccine development against not just COVID-19 but also future pandemic threats.

We have also been actively engaged in research to combat antimicrobial resistance and analyse immune responses and virus structures that are essential to creating therapeutics against flaviviruses like dengue and Zika. The launch of Johnson & Johnson's Satellite Centre for Global Health Discovery at Duke-NUS is a demonstration of EID's strong track record in this area.

Even as we forge new partnerships, we remain committed to established collaborations, especially in the detection of novel pathogens. Through our joint efforts, we have identified a previously undescribed zoonotic henipavirus. In the meantime, we have been dedicated to further strengthening regional capacities for genomic surveillance and epidemiology of infectious diseases.

All these accomplishments are not possible without our devoted programme staff. I would like to thank them for their commitment to driving discoveries toward better management of infectious diseases.



Professor Gavin Smith

Director
Emerging Infectious Diseases Signature
Research Programme

Highlighting the blind spot in SARS-CoV-2 immunity research

In a study published in the *Journal of Experimental Medicine* in October 2022, Professor Antonio Bertoletti revealed that SARS-CoV-2-specific T cells were found in the nasal cavities of individuals who were infected following vaccination, but not in vaccinated yet uninfected individuals.

The study also found that these virus-specific T cells persisted for more than 20 weeks and are expected to confer an additional layer of protection against COVID-19.

By unravelling the immunological response in the nasal cavity, which is the primary site of SARS-CoV-2 infection, in vaccinated and infected individuals, the findings suggest that hybrid immunity—immunity developed through a combination of vaccination and infection—may lead to better protection against the virus.

Shedding new light on key differences in immune response to SARS-CoV-2 vaccines

A Duke-NUS study, led by Professor Antonio Bertoletti and Senior Research Fellow Dr Anthony Tanoto Tan, found that inactivated vaccines, which expose the immune system to the entire non-viable virus, elicit a broad immune response against different proteins on the virus. Published in *Cell Reports Medicine* in November 2022, the findings showed that inactivated SARS-CoV-2 vaccines generate T-cell responses towards other viral proteins, which could be beneficial during an infection.

While larger studies are needed to clarify the impact of the T-cell responses in SARS-CoV-2 pathogenesis, these findings add to the growing literature that will help scientists improve vaccine strategies for an ever-changing virus.

First close-up look at bats' immune response to live infection

In a world first, scientists at Duke-NUS have used single-cell transcriptome sequencing to evaluate immune responses to viral infection in colony-bred cave nectar bats. Published in *Immunity*, the findings provide insights into bat immunity that could be harnessed to protect human health.

The study team, including Professor Wang Linfa, Research Fellows Dr Akshamal Gamage and Dr Feng Zhu, and MD-PhD candidate Mr Wharton Chan, uncovered three striking features in the bats:

- i) a type of white blood cell, called neutrophils, expressed high levels of a gene called IDO1, which is known to suppress immune responses in humans;
- ii) some marked anti-viral gene signatures in white blood cells known as monocytes and alveolar macrophages that guide T cells to recognise the viral particles;
- iii) an abundant population of T cells and natural-killer cells that can kill tumour and virus-infected cells.

These findings could serve as a guide to inform further investigations into the remarkable biology of bats, including their tolerance to viral pathogenesis, the ability to live on a high-sugar diet without getting diabetes and their longevity.

New comparative study provides insight on the rise of Omicron

A team of scientists from Duke-NUS and the National Centre for Infectious Diseases (NCID) found that the Omicron variant escapes the immune response better than other SARS-CoV-2 variants and their related coronaviruses in humans, bats and pangolins.

The research team, which also includes scientists from Thailand, South Africa, Germany, and the UK, investigated immune responses against 20 different sarbecoviruses—members of the subgenus of beta coronaviruses that include SARS-CoV-1, SARS-CoV-2—as well as multiple other coronaviruses found in bats and pangolins, including Omicron.

Their findings, published in the journal *Nature Microbiology*, suggest that Omicron evolved from its ancestors to escape immunity from past infection or vaccination, especially the immunity conferred by neutralising antibodies in humans during the COVID-19 pandemic. The findings are significant in the context of a dynamically evolving pandemic, as they can guide future responses to the pandemic, including the development of more effective and broadly protective vaccines.

Driving the development of dengue vaccines

Using advanced techniques in cryogenic electron microscopy, Professor Lok Shee-Mei's team, along with their colleagues from the UK, have obtained the first high-resolution view of an important dengue virus protein involved in the development of severe disease.

Published in *Nature Communications*, the study revealed that the non-structural protein 1 (NS1), which is presented outside the cell in six- and/or four-unit formats, promotes vascular leakage, a key contributor to dengue haemorrhagic fever.

The development of an effective dengue vaccine has been challenging, given the unavailability of NS1's structural details. By describing the high-resolution structure of NS1, this innovative fundamental research may drive drug and vaccine development efforts and refine treatment strategies against this endemic disease.

New centre to strengthen expertise and capacity in advancing pandemic preparedness across ASEAN

Leveraging the research collaborations and commercialisation successes that have contributed to Singapore's fight against the COVID-19 pandemic, Duke-NUS launched the Centre for Outbreak Preparedness, or COP, on 10 June 2022 to further strengthen regional research capacity, cooperation and preparedness against future pandemics and public health threats.

Deputy Prime Minister and Coordinating Minister for Economic Policies Mr Heng Swee Keat joined some 100 guests at the launch of this new centre. Among the guests were Duke-NUS Governing Board Chairman

Mr Goh Yew Lin as well as members of the board, benefactors, partners and leaders from across the biomedical, healthcare and other sectors.

Highlighting COP's close ties with Duke-NUS and its parent university, the National University of Singapore, COP Director Professor Paul Pronyk stressed that the Centre will leverage Duke-NUS' strong partnerships around the world, with particular focus on research institutes in South and Southeast Asia, to increase the region's research capacity and capabilities.



Guest-of-Honour Mr Heng Swee Keat, Deputy Prime Minister and Coordinating Minister for Economic Policies (centre, front row), and speakers and panellists at the launch of Duke-NUS' Centre for Outbreak Preparedness.

The Centre will also work closely with Singapore government agencies and key partners such as Singapore's National Programme for Research in Epidemic Preparedness and Response (PREPARE), A*STAR's Bioinformatics Institute (BI), the National Centre for Infectious Diseases, as well as with global bodies such as the World Health Organisation (WHO).

With many zoonotic threats originating from the region, the strategic location of the Centre in Singapore provides proximity to this global hotspot and thus timely access to genomic data of the pathogens that pose disease threats.

One study that addresses the need for better genetic surveillance is the Asia Pathogen Genomics Initiative, a collaboration between Duke-NUS and the Bill & Melinda Gates Foundation. This initiative is expanding genomic sequencing capacity across countries in South and Southeast Asia by building capacity and a collaborative platform for policymakers,

researchers and public health specialists across the region.

The event also included a panel discussion on issues such as the need to improve laboratory capacity to study pathogens with pandemic potential, enhance methods for early detection, accelerate innovations in diagnostics, vaccine and therapeutics research and development, and support health system capacity for managing outbreaks.

In addition to Prof Pronyk, the panel consisted of Dr Sebastian Maurer-Stroh, Bill Executive Director; Dr David Blazes, Deputy Director for Genomics, Epidemiology and Modelling at the Bill & Melinda Gates Foundation; Professor Wang Linfa, Executive Director of PREPARE; and Ms Anita Suresh, Deputy Director for Genomics & Sequencing Programme with the Foundation for Innovative New Diagnostics. Ms Salma Khalik, Senior Health Correspondent, *The Straits Times*, moderated the panel discussion.



At the Duke-NUS Centre for Outbreak Preparedness, we are excited to be hosting the secretariat for the Asia Pathogen Genomics Initiative (Asia PGI), a joint effort by the School and the Bill and Melinda Gates Foundation to enhance regional pandemic preparedness by improving genomic surveillance. In bringing together 13 countries in South and Southeast Asia, the initiative aims to massively accelerate the adoption and scale of pathogen genomics across Asia, and support systems for timely data sharing, in an effort to advance regional health security.

Over the past year, we've been taking the pulse of countries to see where they are at and what their needs are. We've recently completed a regional roadmap for early detection, which outlines a game plan for how to allocate resources and optimise technical support.

What's most exciting is that these efforts are truly transdisciplinary. We leverage a decade of support that Duke-NUS has been providing to countries across Asia. For example, our colleagues with the Emerging Infectious Disease Programme pioneer research at the human-animal interface and help anticipate where new diseases might arise. We are similarly able to tap the expertise and networks of the SingHealth Duke-NUS Global Health Institute and the Health Services and Systems Research Programme. Finally, new innovations have to move from the lab bench to the bedside, which is where the Duke-NUS Centre of Regulatory Excellence plays a key role in helping to navigate the complex manufacturing, procurement and regulatory context across Asia.

In addition, external partners such as A*Star's Bioinformatics Institute and the NUS Saw Swee Hock School of Public Health both contribute expertise in bioinformatics and epidemiology/modelling, respectively, to support this initiative.

Taken together, I am excited that the Centre can play a key role in positioning Singapore as a hub of excellence for Asia in advancing pathogen genomics as we work to forge a more health-secure future for generations.



Professor Paul Pronyk

Director
Centre for Outbreak Preparedness

Health Services and Systems Research Programme



In helping the nation fight against the COVID-19 pandemic, our team at Duke-NUS and across the SingHealth Duke-NUS Academic Medical Centre (AMC) devised a multidisciplinary approach, utilising health services and systems research methods, to address issues related to the pandemic and provide policy advice. As we emerge from the shadow of the pandemic, we need to sharpen our focus in addressing the ongoing challenges faced by our healthcare system, especially those related to our ageing population.

Beyond the pandemic, our team at the Health Services and Systems Research (HSSR) Programme will play a positive role in the implementation of the Healthier SG initiative to help manage an increasingly complex and costly healthcare system. At the same time, we are spearheading efforts to integrate interpretable AI-powered decision-making tools into healthcare delivery by building physician trust and conducting robust implementation studies.

In aligning our efforts at HSSR with the nation's healthcare agenda, we will be reviewing our strategic plans and research focus to ensure our relevance in building a resilient health system. We will continue to invest in building capacity in the education and research of health services and systems under the AMC and beyond, while exploring new initiatives to further our engagement with the community, stakeholders, industry and philanthropists.



Professor Marcus Ong

Director
Health Services and Systems Research
Signature Research Programme

Gender-based differences in CPR performance

A study, published in *eClinicalMedicine* in February 2022, showed that women are less likely than men to receive cardiopulmonary resuscitation (CPR) from a bystander in a public location, drawing attention to the role of gender as a deterrent to receiving lifesaving medical care.

The research, led by Associate Professor Liu Nan, was based on an analysis of data from more than 56,000 out-of-hospital cardiac arrest cases across nine Asian communities between 2009 and 2018.

By highlighting the primary reasons behind gender-based differences in CPR performance by bystanders, this cross-nation research could support future public policy initiatives and the development of public bystander CPR training programmes tailored to the needs of communities with diverse ethnic and cultural backgrounds. Dr Ning Yilin, a research fellow with the HSSR Programme and the Centre for Quantitative Medicine, is the study's lead biostatistician.



Associate Professor Liu Nan (front) and Research Fellow Dr Ning Yilin.

A low-cost multi-pronged intervention to reduce hypertension-linked morbidities

A cluster-randomised trial, conducted by scientists and clinicians from Duke-NUS and SingHealth Polyclinics, showed the effectiveness of a low-cost, multi-pronged intervention, using existing primary care resources, in significantly lowering systolic blood pressure (BP) and improving BP control after two years of follow up. The findings, published in *PLoS Medicine* in June 2022, further indicate that the intervention increased patient compliance in the use of antihypertensive medications and reduced cardiovascular risk.

The multicomponent intervention called SingHypertension, which was led by Professor Tazeen H Jafar, addressed common barriers faced by patients and physicians in attaining optimal BP control by

adopting a clinical risk-based treatment strategy that included:

- a) trained physicians prescribing subsidised generic antihypertensive medications, and
- b) nurses motivating patients through conversations and follow-up phone calls.

The intervention can be easily adapted into the primary care system at low costs and has the potential for rapid scalability in Singapore, as well as in other Asian countries with similar healthcare infrastructure and equally high-risk populations and hypertension-related cardiovascular disease burden. Discussions with health departments and advisory committees are ongoing to scale up the intervention across primary care clinics in Singapore.



Professor Tazeen H Jafar (centre) and her team.

Cold spells in the tropics could increase heart attack risk

A study led by Duke-NUS scientists has found an increase in the risk for acute myocardial infarction caused by cooler ambient temperatures, even in a relatively warm part of the world like Singapore.

Co-led by Professor Marcus Ong, and conducted in collaboration with Singapore's National Environment Agency, the research showed that a drop of 1°C in ambient temperature increased the risk of a type of acute myocardial infarction in the population by 12 per cent. Furthermore, people aged 65 and above were 20 per cent more vulnerable to cooler temperatures than younger people.

The report, which was based on data collected from the national health registry over a period of 10 years and published in *Science of the Total Environment*, highlighted how temperature deviations can lead to harmful bodily stress and provided valuable insights for health policies for populations living in the tropics.

Healthcare researchers must be wary of misusing AI

An international team of researchers, including Associate Professor Liu Nan, advised in a commentary published in *Nature Medicine* that strong care needs to be taken not to misuse or overuse machine learning (ML) in healthcare research.

Together with a group of scientists from the UK and Singapore, the researchers highlight that although guidelines have been formulated to regulate the use of ML in clinical research, these guidelines are only applicable once a decision to use ML has been made and do not ask whether or when its use is appropriate in the first place. Instead, the scientists advised evaluating the use of ML algorithms against traditional statistical approaches where applicable and implementing ML to complement rather than to replace clinical decision-making where deemed appropriate.

Next, the team will be organising an international effort to provide guidance on the use of ML and traditional statistics and set up a large database of anonymised clinical data that can harness the power of ML algorithms.

Duke-NUS scientists' work on out-of-hospital cardiac arrests among the top global emergency medicine studies of 2021

A study on increasing out-of-hospital cardiac arrest (OHCA) survival rates, led by Professor Marcus Ong and first published in *Resuscitation*, was included in a compilation of high-quality emergency medicine articles from 2021 by the Global Emergency Medicine Literature Review Group.

Selected from an initial pool of more than 44,000 articles, Prof Ong's study was among the top 23 articles that met the Review Group's stringent criteria for clarity, study design, global importance and relevance as well as the likely impact on the global practice of emergency medicine.

The compilation was published in *Academic Emergency Medicine* in August 2022.

Neuroscience and Behavioural Disorders Programme



With a return to normalcy last year, we focused on expanding our research network through renewed in-person communications and activities. In October 2022, the Duke and Duke-NUS Neurodegenerative Colloquium was held at Duke University, bringing together neuroscientists across both institutions for a constructive exchange of ideas and sharing of latest updates. Such exchanges sow the seeds for new research collaborations, which I am confident will continue to flourish in the years to come.

As well as expanding our network of collaborators, at the Neuroscience and Behavioural Disorders (NBD) Programme, we are committed to nurturing young researchers by creating a lively environment where exciting research discoveries are made, innovations are dreamt up and tested, and collaborations are forged with partners from the local and international neuroscience space.

Besides fundamental research, NBD faculty and staff also filed invention disclosures and patent applications for microscope-design technologies and cell therapies for stroke and other neurological disorders. These accomplishments would not have been possible without the contributions of our outstanding graduate students and postdoctoral fellows. It is particularly encouraging to see young researchers awarded research grant support at the School and national level, bringing them a step closer to their goals of becoming independent principal investigators.



Professor Zhang Suchun

Director

Neuroscience and Behavioural Disorders
Signature Research Programme

Understanding mosquito-biting behaviour to develop more effective dengue control strategies

A research study led by Associate Professor Adam Claridge-Chang from the Neuroscience and Behavioural Disorders (NBD) Programme and Associate Professor Ashley St John from the Emerging Infectious Diseases Programme, along with scientists from France, has used high-resolution videos to reveal that dengue infection in mosquitoes increases their attraction to humans. While the biting efficiency of these mosquitoes decreased, they bite more often, thus tripling their disease transmission potential.

The findings, published in *Proceedings of the National Academy of Sciences* in January 2022, could contribute to the development of more effective disease control strategies against dengue, an area of work where scientists have been unsuccessful so far.

As the next step, the research team hopes to understand the molecular mechanisms behind these changes to mosquito behaviours. If the scientists can identify a gene or protein responsible for the changes, scientists might be able to design chemicals targeting them.

Learning about human cancer from fruit flies

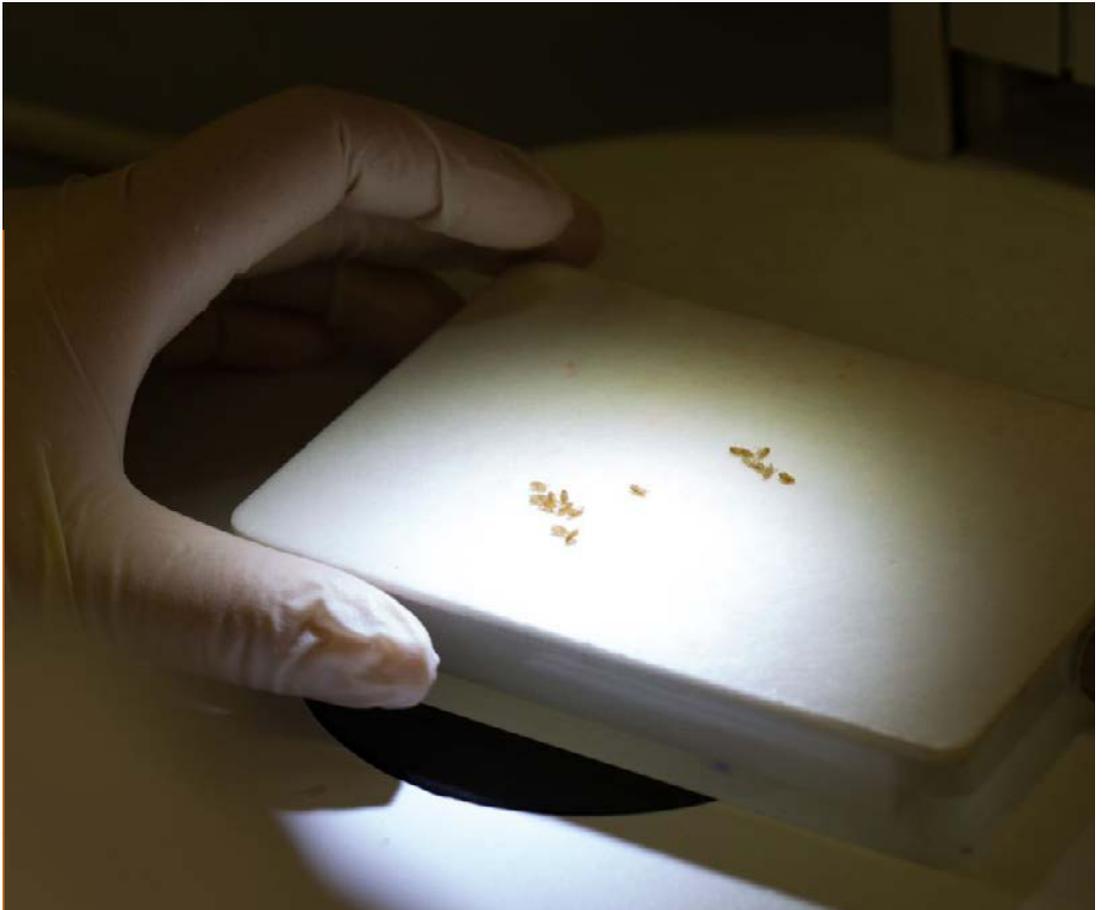
Studying fruit flies, scientists in Singapore and Spain have gained new insights into the activity of a tumour-suppressor protein called parafibromin that could aid the understanding of the molecular pathways in some human cancers.

The study, published in *PLOS Biology* in October 2022, examined the role of Hyrax—the fly analogue of parafibromin—in brain cell development and revealed previously undiscovered functions for the protein in controlling cell polarity—the asymmetric organisation of proteins—in stem cells that generate mature nerve cells.

The loss of Hyrax function led to an overgrowth of neural stem cells in the fly brain. This caused alterations in cell structures called centrosomes, which coordinate cell division, and the regulation of two other known tumour-suppressor proteins, polo and aurora-A kinases.

As loss of cell polarity and centrosomal abnormalities are hallmarks of human cancers, these findings may be relevant for understanding the role of parafibromin in human cancers, especially in the brain.

Professor Wang Hongyan, Deputy Director of the NBD Programme, is the corresponding senior author of the study, and Dr Deng Qiannan, a Research Fellow with the Programme, is the first author of the study.



Although fruit flies and humans may look very different, researchers often find that crucial molecular pathways, signalling and control systems are shared across many species.



In 2022, faculty and staff at the Centre for Ageing Research and Education (CARE) developed research in several areas including population health, caregiving, falls, loneliness, ageing and the environment, medication management, dental health, and screening for sensory impairments. This work was published in 24 peer-reviewed publications in top ageing journals including the *Journal of Gerontology Series B*, *Geriatrics and Gerontology*, *Journal of Ageing and Health*, and *Ageing and Society*.

Some of the papers were also presented at major scientific conferences including the meetings of the Gerontological Society of America and the Population Association of

America. Locally, CARE provided scientific evidence to the Ageing Planning Office in Singapore for programming and policy development. On the educational front, CARE's education arm held six expert lectures and webinars in 2022, which attracted more than 2,000 local and international participants. CARE faculty conducted six fully-subscribed workshops focused on research methodologies.

In 2023, CARE will continue its existing work, conduct roundtables and seminars, and coordinate the Ageing Research network which comprises all eight ageing centres. We will also launch one of our largest cohort studies which will recruit 10,000 older adults, aged above 60, longitudinally until 2025.

Associate Professor Angelique Chan

Executive Director
Centre for Ageing Research and Education

Better work, care options needed as Spore set to be 'super-aged' society

This is the seventh of 12 primers on current affairs issues under a programme by The Straits Times to reach out to younger audiences on topics that matter to them



Theresa Tan
Senior Social Affairs Correspondent

If you are a Singaporean, chances are you will live to a ripe old age. In fact, Singaporeans now top the world when it comes to the longest life spans - with a life expectancy of 83 years for men and 87 years for women, said Health Minister Ng Jeng Guan in March.

But beyond the longevity sweepstakes, the Lion City has gone from being an ageing to an aged society. That's one where more than 14 per cent of the population are aged 65 and older, compared with more than 7 per cent for an ageing society as defined by the United Nations.

The share of Singapore citizens aged 65 and older has increased from 14.4 per cent in 2011 to 17.6 per cent last year, according to data published by the Singapore Government last year.

And that proportion is expected to increase to about 23.8 per cent in 2030, when Singapore will join the ranks of super-aged societies, like Japan and Italy, where over 30 per cent of the population are aged 65 and older.

So how did Singapore get so old, so fast?

A dramatic rise in life expectancy, coupled with a sharp fall in birth rates, has led to the rapidly greying society.

As Singapore hurtles towards the ranks of the super-aged, what needs to be reimagined so that both young and old can continue to live well?

EXPERT SAYS AGEISM, LIKE RACISM AND SEXISM, AFFECTS ALL WORKPLACES

In 2015, the Government unveiled its Action Plan for Successful Ageing, a road map to help Singaporeans age confidently. It set out plans to draw from employment and healthcare to retirement adequacy and voluntarism.

Then Health Minister and chairman of the Ministerial Committee on Ageing Kishin Yong-saik: "We need to plan ahead to ensure that Singaporeans need not worry about getting old, but instead embrace new opportunities that come with longevity."

"We want Singapore to be the best place for Singaporeans to grow old, and a model for successful ageing."

One challenge that Singapore has grappled with since the 1990s is how to help people who live as long as life spans lengthened.

In 1993, the Government introduced the Retirement Age Act, setting the retirement age at 60, up from 55 - the Central Provident Fund (CPF) withdrawal age at that time.

In 2012, the Retirement and Re-employment Act came into force. It marked a major shift for many workers as they continued to work beyond the retirement age if they were able and wanted to, and employers were required to keep hiring them in the re-employment age.

Last year, the Government announced the next extension, which will see the retirement age progressively raised to 65 by 2030, and the re-employment age to 70.

Even with these changes, retirement adequacy - a term that refers to people having enough money to retire on - remains a major concern for many.

Studies have found that the majority of Singaporean older adults, such as those aged 65 and older, continue to work out of necessity, said Dr Arthur Chia, senior research fellow at the Centre for Ageing Research and Education (Care) in the Duke-NUS Medical School.

Besides changes to the law, Singapore has also launched a massive push to help its workforce stay economically relevant, through skills upgrading, mid-career transition schemes, job placement and job redesign grants for firms.

Public spending on such schemes is significant, but problems remain.

Dr Chia said many older Singaporeans, especially those with less education, still find it a challenge to find new work and stay employable.

Many of the jobs less-educated older workers hold are also on a temporary or fixed-term basis, which are often associated with poorer employment terms.

Other job-related setbacks in the way of older workers are ageist attitudes and mindsets.

"I think ageism - like racism and sexism - affects all workplaces and forms of work," said Dr Chia.

"It isn't mandated, it is not only poisons work relations and affects workers' morale, but also affects organisational or work culture when ageist perceptions and practices become institutional norms and habits."

"The effect on productivity in the long term would be adverse as it erodes away human dignity,

mutual trust and understanding."

In 2009, Care conducted focus-group discussions with 39 people aged 65 and older. They included both professionals, managers, executives and technicians (PMEFs) and non-PMEFs.

The respondents spoke of having their pay cut as their employment terms changed, opaque hiring processes and mismatched expectations on what the workers think they can do based on their experiences and capabilities and what their bosses ask them to do.

Some also shared that they had experienced outright bullying by their bosses and the use of derogatory language against them, and said they felt these were due to their age.

Dr Chia said such experiences add to older workers' sense of inadequacy at the workplace.

Studies have also shown that internalising as well as exposure to negative age stereotypes negatively affect the physical and cognitive health of older people, he warned.

Work options past age 60 and over "to maintain an area where a cultural shift needs to take place, with much room for re-imagining."

ADDRESSING THE MISSING MIDDLE

Given the rapid pace of ageing and with Singaporeans living longer, many seniors and their families will need long-term care options other than nursing homes or domestic helpers - which is the norm now.

A growing share of these seniors is likely to be either single or married with no children.

These seniors are not ill enough to need the 24/7 care provided by nursing homes. They would prefer the independence of living on their own, with some help but not too much.

For now, there are not enough assisted living options to cater to the needs of this group, leading experts to coin the phrase "missing middle" to refer to this gap in Singapore's long-term care options.

Assisted living options are facilities where seniors live in flats or apartments, but also receive support in the form of meal services, housekeeping and medical care and supervision.

Such facilities also benefit the children of seniors. Their caregiving burden becomes considerably lighter when they have an option to let their parents continue living on their own, but with professional support services delivered to their doorstep.

However, assisted living is still in its nascent stage here, compared with other developed countries, said Chia Hui Xiang, research assistant at the Institute for Global Health Transformation at the National University of Singapore Saw Swee Hoek School of Public Health.

This is due to reasons such as the higher per capita income in the healthcare sector, and the doubts private providers have about the financial stability of running such facilities.

Still, a handful of public and private players are now piloting small projects in this field.

From the public sector comes a new housing option called Community Care Apartments, a joint effort by the ministries of Health and National Development, and HDB, the public housing agency that has built homes for the vast majority of Singaporeans.

The first such project in its Bukit Merah, will about 100 units, expected to be completed in 2024.

The second will be launched in October next year in the year with about 200 flats.

These are small flats for those aged 65 and above, and provide seniors with housekeeping, caregiving and round-the-clock

emergency medical services.

A handful of entrepreneurs have also ventured into the sector. An early mover was Dr Felicia Wee, the nurse Bernadette Lifestyle Village, which provides a higher-end offering in three landed properties where seniors live in flats of ensuite double and single rooms.

Another new entrant is Mr Joshua Goh, 42, an architect by training with experience in running co-living spaces for millennials.

He set out to find an assisted living option for his father, and ended up setting up Red Cross Senior Living, which has more than 130 residents in 28 shared apartments, a mix of HDB flats and private apartments.

Still, they know that care and needs to be done, said Ma Chia.

For her, the reimaging of long-term care options should go beyond meeting seniors' medical and physical needs which do not go away with age.

"We know that care and more tech savvy than the low-income seniors, and so are likely to have greater expectations when it comes to their desired long-term care options and the quality of life."

Since today's offerings may not cut it for more discerning seniors, it remains for policymakers, entrepreneurs and non-profit groups to reimagine how Singapore and even, and culture, might be further improved to cater to the needs of parents and grandmothers, and their own too, further down the road.

theresat@sp.com.sg

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Research in computational biology is at the forefront of 21st century biology. At the Centre for Computational Biology, we not only focus on decoding complex biological processes but also on advancing personalised medical treatments that are expected to become a regular feature of healthcare in the near future. In doing so, the Centre connects with the School's various Signature Research Programmes and draws synergies through collaborations with our academic medicine partner SingHealth, to deep dive into areas including systems biology, translational genomics, computational modelling and machine learning in biomedical research.

For example, our faculty, together with their collaborators from the Singapore General Hospital, support the National Medical Research Council (NMRC) Clinician-Scientist Award project on fibrosis in glaucoma surgery. We are also part of the NMRC-funded Open Fund Large Collaborative Grant Diabetes Study in Nephropathy and other Microvascular Complications II, or DYNAMO II, studying diabetic complications which is led by the Cardiovascular and Metabolic Disorders Programme.

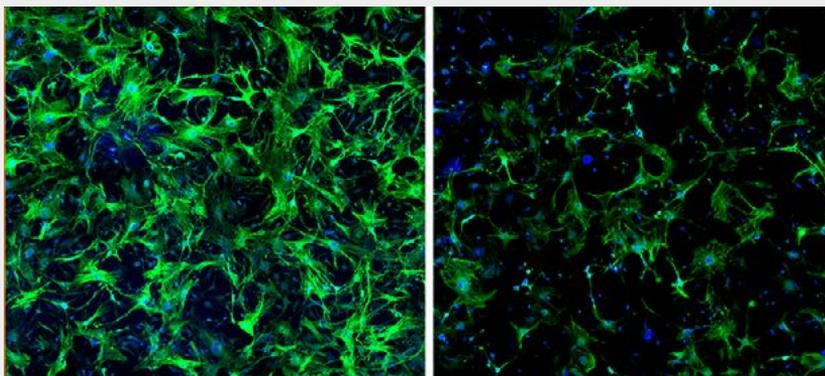
Even as we continue our efforts to enhance research capacity, the Centre is committed to engaging in cutting-edge research which helps shed light on important biomedical topics. One prime example is the discovery of a gene that controls the behaviour of a specific type of cardiac macrophage responsible for excessive scarring during the early phases of common heart diseases or cardiomyopathies. When the gene, called WWP2, is blocked, heart function is improved and scar tissue formation is slowed, delaying the progression to heart failure.

I am pleased to see so many accomplishments of the Centre in the past year. Looking ahead, the Centre will continue with its good work to further the science of biomedicine through applications of big data.



Associate Professor Enrico Petretto

Director
Centre for Computational Biology



Microscopy images that show fibroblasts were "incited" either by macrophages expressing WWP2 (left panel) or by macrophages lacking WWP2 (right panel).



// The Centre for Quantitative Medicine (CQM) was abuzz with activities and growth in 2022, with more than 150 peer-reviewed scientific articles published in both the statistical and applied space. These include two that appeared on the cover of *The American Journal of Public Health* along with an accompanying podcast with the journal's editor-in-chief. The articles were part of an intentional research grant initiative that brought in more than \$2.5m dollars in grants to promote methodological developments.

On the educational front, we have increased both the quality and number of applicants to the PhD programme in Quantitative Biology and Medicine, and the number of funded PhD slots, towards an overall pool of 20 PhD students in the programme. Three new PhD students—coming from Columbia University, Yale University and University of Southern California—will join us in 2023. A PhD mentor training programme was launched to pair junior mentors with experienced ones during their initial years of mentorship.



A paper published by Ms Xinru Wang from the Quantitative and Medicine PhD Programme makes the cover of the American Journal of Public Health.

In building our research and education capacity, we have enrolled three jointly-appointed faculty from the Duke University Biostatistics and Bioinformatics department, who can serve as both research partners in grant submissions, and mentors to doctoral students.

A new CQM seminar series was introduced in 2022 to celebrate our research accomplishments and it comes in two flavours: Statistics in Action which pairs a talk by a CQM faculty member about a method they have created or improved with a clinician or researcher who employed that method to address a clinical problem, and Statistical Methods, where experts across the globe are invited to present cutting-edge methodologies and their applications.

Finally, we have responded to the increasing focus on global and population health initiatives by creating

the Population Health Research and Outcomes Group which provides state-of-the-art solutions to complex global initiatives. These include design implementation; data collection, management and analysis including cost-benefit analyses.

Professor Roger Vaughan

Director
Centre for Quantitative Medicine



“Forward-looking” was a resonating theme for many of our engagements in 2022 in facilitating equitable access to therapies of good quality, safety, and efficacy in the Asia-Pacific region, and promoting innovation to strengthen health products and health policy regulation.

We successfully held the 2022 Scientific Conference with the theme of ‘Patients as partners for health: Co-creating equitable access to health products and services’, where local and global partners of the Centre’s Coalition to Accelerate Patient Engagement shared best practices in patient engagement initiatives.

We established a new partnership with the Health Regulation Group of Singapore’s Ministry of Health (MOH) with the vision of making Singapore a regional thought leader in healthcare services regulation and promoting best practices across the region. Centre of Regulatory Excellence (CoRE) is conducting a horizon scanning project supporting MOH in enhancing regulatory policies, while also assisting in the establishment of an Asia-Pacific network of healthcare regulators to facilitate learning from each other in an increasingly complex environment. In strengthening existing partnerships, an MOU was signed with the Council for International Organisations of Medical Sciences to work together in mutual areas of interest such as promoting thought leadership and excellence in regulatory science.

Through our signature Sir Alasdair Breckenridge Lecture and Graduation ceremony, we celebrated the largest cohort of graduates from our Graduate Certificate Programme. To enhance our education portfolio, two Executive Certificates were launched in collaboration with Diagnostics Development Hub on the development and regulation of in-vitro diagnostic devices and software as a medical device.

In 2023 and beyond, CoRE will continue our strategic partnerships, including collaborating with the Asian Development Bank to strengthen regulatory systems in developing member countries. Enhancing the regulation of digital health will be another key focus as we engage in discussions to promote collaborations across ASEAN and Asia-Pacific to accelerate the digital transformation in health product development and its associated regulatory frameworks.



Professor John Lim

Executive Director
Centre of Regulatory Excellence



Guests and speakers at the 2022 Scientific Conference organised by CoRE.



2022 was a year of restarting under the new normal. In addition to another successful year of generating high-quality grants and publications, we held our first in-person conference since the start of the pandemic, reinstated in-person courses while also offering many blended learning and online options, and re-engaged with local and regional collaborators.

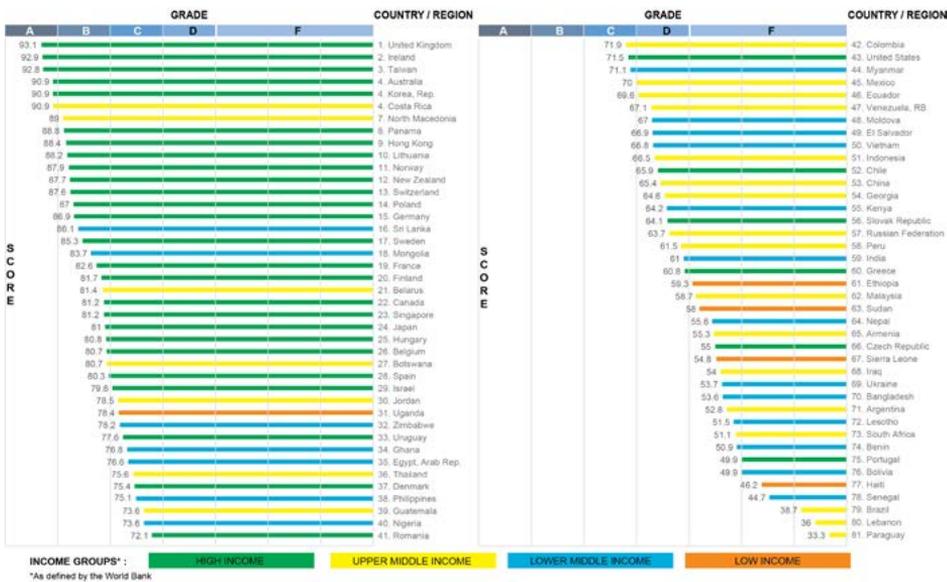
The Centre remained committed to furthering our mission which is to implement and incubate high-quality research and education projects that address the physical, psychological, and social needs of those affected by a life-limiting illness.

We generated international discussions on how best to improve end-of-life care through the publication of the Cross-Country Comparison of Expert Assessments of the Quality of Death and Dying and via participation in the Lancet Commission on the Value of Death. These efforts will continue into 2023 as we look to fulfil our vision of being the premier palliative care centre in the region.

Professor Eric Finkelstein

Executive Director
Lien Centre for Palliative Care

Countries ranked by quality of end-of-life care



The cross-country study was conducted jointly by researchers from Duke-NUS' Lien Centre for Palliative Care, Duke University Global Health Institute and their collaborators, and outlined in three papers published in the Journal of Pain and Symptom Management 2021.

The research ranked 81 countries on how well their health systems provide for the physical and mental wellbeing of patients as part of end-of-life care. While just six countries earned A grades, 36 earned Ds or Fs, highlighting the urgent need to address the striking gaps in palliative care in low and middle-income countries.

Conducted against the backdrop of COVID-19 when mortality was more commonly addressed, the research could serve as a catalyst to bring a renewed focus on end-of-life care as COVID has made death less taboo.



The Pre-hospital and Emergency Research Centre (PERC) has made considerable progress since it was launched in 2021. Despite the operational challenges posed by the COVID-19 pandemic, PERC has published more than 50 papers, received S\$6.8m in research grants, and garnered 10 awards in the past two years. The Centre currently has 10 PhD candidates and Masters students conducting research in emergency topics. The Centre also hosted its first international research fellow, as we establish ourselves as a centre of excellence.

Guided by our steering committee, which comprises local and global emergency care leaders, we have built a hi-tech, 'living laboratory-like' research environment relevant to local and global emergency care. Leveraging our close partnership with the Singapore Civil Defence Force and the Unit for Prehospital Emergency Care under the Ministry of Health, we provide a supportive setting for pre-hospital interventional trials in order to further enhance our capacity in this area.

Aiming to improve morbidity and mortality after out-of-hospital cardiac arrest, PERC has initiated multiple exploratory and interventional research projects. Among those is the development of a simulation sandbox enabling computer simulations to pre-test the system-wide effects of proposed emergency care interventions. In the meantime, PERC is running an evidence collation programme to bring research efficiency through evidence-based hypothesis generation while providing a training opportunity for the young blood entering the field of medicine.

Even as we continue to build our own research capabilities, we also actively engage in collaborative research efforts with regional and global partners, enlarging our footprint beyond Singapore's borders. I am confident that the Centre will continue pressing on with its good work in the years ahead!



Professor Marcus Ong

Director
Pre-hospital and Emergency Research Centre



Professor Ong (second from left) speaking at the Prehospital Emergency Care in Southeast Asia seminar jointly organised by the Centre, Temasek Foundation and SingHealth Duke-NUS Academic Medical Centre.

Empowering women in science

Launched in 2007, the Duke-NUS Women in Science (WinS) network continues to grow and flourish. In 2022, WinS worked together with the community to ensure gender, ethnic and cultural diversity, equity and inclusion of all of staff, students, and trainees to drive sustainable progress.

Coinciding with International Women's Day, a leadership seminar titled 'break the bias to empower yourself and others to thrive at work' was organised on 9 March 2022. The event aimed to empower attendees to break through the various barriers that they face in the workplace.

In the same week, a panel discussion on the topic 'diversity, innovation and entrepreneurship in academia' was held to bring the Singapore Women in Science (SgWIS) community together. The panel discussed the challenges and opportunities facing academic institutions in engaging women and under-represented groups to break into the entrepreneurship space to advance innovations.

Throughout the week-long celebration for International Women's Day, WinS

also sponsored at-home movie viewing gatherings, featuring the movie 'Picture a Scientist', which challenged some of commonly held stereotypes such as what a scientist should look like.

Career advancement programme to cultivate future leaders

The organisation of these events built on WinS' strong track record of putting forward diverse initiatives to support female scientists and clinician-scientists across the SingHealth Duke-NUS Academic Medical Centre.

One such initiative is WinS-Career Advancement Programme (WinS-CAP) which was launched with the mission to advance and develop the careers of female research scientists across the AMC at all professional and training levels.

After the successful graduation of the inaugural cohort in October 2020, the second run of WinS-CAP saw 20 talented early career female scientists from the AMC graduate in 2022.



Participants from the inaugural cohort of WinS-CAP during a mentoring session.



Awards

Asian Scientist Lab Tech of the Year 2021 MiRXES COVID-19 Hero Award

Ms Kamini Kunasegaran, then a research assistant with Professor Antonio Bertoletti's lab in the Emerging Infectious Diseases Programme, received the Asian Scientist Lab Tech of the Year 2021 MiRXES COVID-19 Hero Award, in recognition of her excellent work in support of Singapore's fight against the pandemic.

The Asian Scientist Lab Tech of the Year Award recognises laboratory technicians working in Singapore's STEM and healthcare ecosystem.



Ms Kamini Kunasegaran (centre) and Professor Antonio Bertoletti (left) from the Emerging Infectious Diseases Programme receive the Asian Scientist Lab Tech of the Year 2021 MiRXES COVID-19 Hero Award.

National Medical Research Council Award Winners 2022

In 2022, two teams received the National Medical Research Council Open Fund-Large Collaborative Grant of S\$25 million each for their research in liver cancer and glaucoma.

Twenty clinician-scientists and researchers received talent development awards under the Singapore Translational Research Investigator Award, Clinician-Scientist Award and the Transition Award categories.

In addition, two healthcare professionals, including an allied health professional, received the Clinician Innovator Award and three clinician scientists received the Health Promotion, Preventive Health, Population Health and Health Services Research (HPHSR) Clinician-Scientist Awards (HSCA) - Investigator Award.

2022 winners for the national grants are:

Open Fund-Large Collaborative Grant S\$25 Million

Precision Medicine in Liver Cancer across an Asia-Pacific Network (PLANet 2.0)

Professor Pierce Chow and his team from NCCS, A*STAR's GIS and IMCB, CSI Singapore and Duke-NUS

Tackling & Reducing Glaucoma Blindness with Emerging Technologies (TARGET)

Professor Aung Tin and his team from SERI, CGH, Duke-NUS, A*STAR, NTU and NUHS

Singapore Translational Research Investigator Award

Professor Marcus Ong
SGH, Duke-NUS

Professor Stuart Cook
NHCS, Duke-NUS

Associate Professor Toh Han Chong
NCCS, Duke-NUS

Clinician-Scientist Award – Investigator

Dr Adeline Ng
NNI, Duke-NUS

Assistant Professor Angela Koh
NHCS, Duke-NUS

Associate Professor Donny Hoang
SNEC, SERI, Duke-NUS

Associate Professor Gavin Tan
SNEC, SERI, Duke-NUS

Dr Lim Tze Peng
SGH, Duke-NUS

Associate Professor Liu Yu-Chi
SNEC, SERI, Duke-NUS

Assistant Professor Saumya Shekhar Januar
KKH, Duke-NUS

Assistant Professor Shweta Singhal
SNEC, SERI, Duke-NUS

Associate Professor Sng Ban Leong
KKH, Duke-NUS

Clinician-Scientist Award – Senior Investigator

Professor Tina Wong
SNEC, SERI, Duke-NUS

Transition Award

**Clinical Associate Professor
Chong Shu-Ling**
KKH, Duke-NUS

Assistant Professor Francis Wong
SKH, Duke-NUS

Clinical Assistant Professor Jason Chan
NCCS, Duke-NUS

**Clinical Assistant Professor Lohendran
Baskaran**
NHCS, Duke-NUS

Associate Professor Marcus Ang
SNEC, SERI, Duke-NUS

Dr Oh Choon Chiat
SGH, Duke-NUS

Dr Troy Puar
CGH, Duke-NUS

Clinician-Innovator Award

Dr Jasmine Ong
SGH

Dr Tay Hsien Ts'ung
SGH, Duke-NUS

Health Promotion, Preventive Health, Population Health and Health Services Research Clinician-Scientist Awards - Investigator

**Associate Professor Charumathi
Sabanayagam**
SERI, Duke-NUS

Associate Professor Low Lian Leng
SCH, Duke-NUS

Dr Tham Yih Chung
SERI, Duke-NUS

Duke-NUS scientists featured prominently in top global researcher rankings

Following a strong showing in 2021, several Duke-NUS clinician-scientists and researchers continued to make an impact, with six experts named among Clarivate's Highly Cited Researchers. In a separate ranking, compiled by Stanford University called the World's Top 2% Scientists List, more than 80 researchers from the School and SingHealth Duke-NUS Academic Medical Centre (AMC) ranked in the top 2% of scientists worldwide.

The annual Highly Cited Researchers list recognises researchers who have published multiple highly cited papers in the last decade and demonstrated scientific excellence in one or more of 21 fields. The ranking uses both quantitative and qualitative analyses, and this year, more than 7,225 researcher awards issued to 6,938 individuals from 69 countries and regions were announced—3,981 in specific fields and 3,244 for cross-field impact.

Among those recognised for their cross-field impact were Professors Antonio Bertoletti from the Emerging Infectious Diseases Programme and Derek Hausenloy from the Cardiovascular and Metabolic Disorders Programme, who were recognised for the second time in a row. Professor Wang Linfa's work in the field of microbiology also earned him a place on the list.

In 2021, Prof Wang was recognised for his contributions in the cross-field category. Professor Jenny Low and Assistant Professor Shirin Kalimuddin from the Emerging Infectious Diseases Programme also made the list in the cross-field research category. In addition, Professor Carolyn Lam with the SingHealth Duke-NUS Cardiovascular Sciences Academic Clinical Programme was once again recognised in the clinical medicine category.

Many of them also made the Stanford ranking, which identified top-cited scientists in 22 categories using standardised information about a range of factors including citations, h-index as well as a composite indicator, known as a c-score.

In that ranking, a group of more than 80 scientists representing the School and the AMC were recognised. Among this group are Duke-NUS' Health Services and Systems Research Programme Director Professor Marcus Ong, Cancer and Stem Cell Biology Programme Director Professor David Virshup as well as Centre for Ageing Research and Education or CARE Executive Director Associate Professor Angelique Chan.

Cross-field



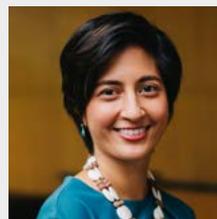
Professor Antonio Bertoletti
Emerging Infectious Diseases Programme



Professor Derek Hausenloy
Cardiovascular and Metabolic Disorders Programme



Professor Jenny Low
Emerging Infectious Diseases Programme



Assistant Professor Shirin Kalimuddin
Emerging Infectious Diseases Programme

Clinical medicine



Professor Carolyn Lam
SingHealth Duke-NUS Cardiovascular Sciences Academic Clinical Programme

Microbiology



Professor Wang Linfa
Emerging Infectious Diseases Programme

OFFICE OF EDUCATION

Sowing the seeds of innovation





// Research-driven, adaptable, innovative and creative are the four keywords that I will use to describe Duke-NUS. And it is clear that the people at Duke-NUS are passionate when it comes to cultivating well-rounded, future-ready clinicians. //

Mr Wharton Chan
Class of 2023 MD-PhD candidate



Future-ready: Duke-NUS' medical education prepares for a future beyond tomorrow

As the demographics of the population evolve, so does the need for tools to nurture future-ready clinicians who can advance medicine to address emerging healthcare issues.

Sharing his views on the future of healthcare, Mr Wharton Chan, an MD-PhD candidate at Duke-NUS, said, "I think the driving force for healthcare is an interplay between what the population needs and the development of technology."

"Singapore has an ageing population which means that there's more of a slant towards healthy ageing and dealing with diseases that come with age. But at the same time, we have technology that's coming into play that will change how we practise as well," added Mr Chan, who participated in the 2022 Nobel Prize Dialogue with two fellow PhD candidates discussing the future of healthcare.

And Duke-NUS' 'Clinician First, Clinician Plus' educational approach to medical training squarely aims at equipping its students with the right skillset through an innovative, technology-driven curriculum. Simulations, for example, train students for the intensity of emergency situations, help them hone essential teamwork skills and equip them to respond to unexpected situations.

"Using these technological solutions, the School prepares us how to react in times of unexpected emergencies," said Mr Chan. But technology is not the solution for all. "While technology provides us with ease and efficiency, it also removes the human touch. And that's going to be an issue that we have to balance."

To Chan, Duke-NUS' curriculum strikes that balance between using technical

tools and harnessing humane patient care. "Other than medical knowledge, we are also trained how we interact and care for patients so that we have both subjective and objective information."

Another distinct feature of the School's curriculum in ensuring students' future readiness is the mandatory research project all medical students at Duke-NUS have to complete.

"Science and medicine are a continuous body of work that's constantly evolving. Whether you want to become a clinician or a clinician-scientist or a researcher after graduation, research provides an avenue for you to review literature and keep abreast of the latest technological advancements in the biomedical field," said Mr Chan, drawing on his own experience working in the lab of world-renowned bat-borne virus expert Professor Wang Linfa from the Emerging Infectious Diseases Programme.

During the pandemic, Mr Chan collaborated with Prof Wang and members of the lab to actively advance COVID-19-related research and innovation.

"I was extremely honoured to be able to work with the virus itself and contribute to studies that helped combat COVID-19," said Mr Chan. "We were not only creating a resource of knowledge for the medical community but also providing a practical response to the pandemic."

Mr Chan also expressed his gratitude to Prof Wang for his mentorship. "If a student requires more support, he will always make time for the student despite his busy schedule," Mr Chan said.

Congratulations, Class of 2022!



Watch the highlight video of the Class of 2022's Graduation & Hooding Ceremony.

On 28 May 2022, Duke-NUS celebrated the graduation of the Class of 2022, which included the largest number of PhD graduates since the School's inception. For the first time in two years, the graduates, their families and invited guests, who were joined by Guest-of-Honour Mr Chan Chun Sing, Minister for Education, were able to attend the ceremony in person.

The Class of 2022 comprised 50 Doctor of Medicine (MD) Programme students, who received joint degrees from Duke University and the National University of Singapore; three MD-PhD

and 13 PhD students. Among the MD-PhD graduates was Dr Matae Ahn, who took an unconventional route. After completing his PhD, he stayed on as a research fellow before going back to complete his final MD year in 2021.

The School also recognised graduating students who excelled academically and for their community service and leadership abilities. The awards included the Singapore Medical Association's Lee Foundation Achievement Prize and the Academy of Medicine's Singapore Medal for Outstanding Leadership.



Minister for Education, Mr Chan Chun Sing (second from right), and Duke University Chancellor Professor Eugene Washington (right) congratulate graduands from Duke-NUS' Class of 2022 as they wait for the Graduation Ceremony to begin.

Welcoming the 16th cohort of medical students



Watch the highlight video of the Class of 2026's White Coat Ceremony.

On 19 August 2022, Duke-NUS' latest cohort of 72 highly accomplished students donned their white coats as they officially marked the start of their studies during the White Coat Ceremony.

Coming from diverse backgrounds, the Class of 2026 was also the first batch of students to benefit from the School's recent curriculum change of introducing social prescribing into the first-year of the Doctor of Medicine (MD) Programme. This new course trains tomorrow's doctors to direct patients to the community to improve their health and lifestyles—in line with the commitment of the Ministry of Health to prioritise population health with community support.

Like their predecessors, each student joining Duke-NUS had to first go through a rigorous evaluation process overseen by a high-level committee. In addition to having a bachelor's degree and high scores in the Graduate Medical School Admissions Test or

Medical College Admission Test, they also had to demonstrate that they have what it takes to be part of the next generation of doctors through their academic and personal attributes.

While most students came with strong science backgrounds, Duke-NUS' characteristically diverse intake also included students with degrees—and, in some cases, careers—in history, accounting, education, engineering and other non-science subjects. This year's cohort also included four students with Master's degrees and three students with PhDs.

In addition, nine students were admitted through Duke-NUS' conditional admissions pathways. They will bring different perspectives and skills into the constantly evolving medical landscape. The conditional admissions pathways are offered to outstanding students, so that they can remain engaged with the medical community during their undergraduate studies.



Duke-NUS Master Academic Clinician Associate Professor Ong Biauwei, Group Chief Risk Officer, SingHealth, and senior anaesthesiologist from Sengkang General Hospital, snaps a selfie with the Class of 2026 at the White Coat Ceremony.

Providing innovative education

With the shift of the global healthcare system towards population health, Duke-NUS is preparing its students for the future of medical practice, which emphasises “health” care over “sick” care. Over the past year, a number of refinements were introduced to the curriculum for the Doctor of Medicine programme for first-year medical students to ensure students graduate with the right skills to support their patients.

Social prescribing for healthcare

One key skill that the next generation of doctors needs to master is social prescribing. This approach, which is gaining momentum in family medicine, focuses on empowering patients to live healthier lives by managing their illnesses effectively and utilising community resources, such as senior activity centres, to improve their overall wellbeing. By teaching patients how to access resources, doctors can enhance patients’ health, mental wellbeing, and lifestyle in the long term.

With the introduction of social prescribing early in the medical

curriculum, Duke-NUS students are encouraged to consider patients’ needs beyond their current illnesses and view patient-centred care from a bio-psychosocial perspective.

The first cohort to benefit

The Class of 2026 at Duke-NUS is the first cohort to benefit from early exposure to social prescribing in their medical education. During the first few months of their studies, students engage in clinical attachments where they can talk to patients to understand their experiences, daily routines, and plans after discharge. This allows students to get to know patients as individuals and connect them with resources available to them in the community, incorporating humanities into the practice of medicine.

By learning social prescribing at the start of their studies, students are left with a lasting impression as they progress through their medical studies. They develop a mental model of seeing patients as individuals to care for and improve their wellbeing.



At the Outram Community Hospital, students chat with a patient to find out more about his condition.

Bringing students to the heart of the community

To truly understand the social determinants of health and the resources available to patients in the community, Duke-NUS students participate in attachments at Senior Activity Centres. These centres, located in HDB rental blocks, encourage active ageing and provide opportunities for seniors to engage in activities and socialise. Community Nurse Posts within the centres offer access to health services. This first-hand experience allows students to see the impact of community resources on patients' wellbeing and understand the importance of addressing patients' needs beyond their hospital stay.



Duke-NUS first-year students with a senior staff nurse and worker at the Thong Kheng Seniors Activity Centre.



Studying at Duke-NUS has been a dream come true for me. While the journey has been tough—with steep learning curves—I really enjoy working alongside the amazing and ambitious peers in my cohort. They are not only hard-working but also bring with them breadths of experiences and depths of compassion that continue to inspire me. That together with the many and varied challenges faced by the healthcare field motivate me to excel in my studies as well as in the outreach and innovation initiatives that I have participated in.

To study at Duke-NUS has been life-changing and is only possible through the kind donations made by donors who care for the future of medicine. I am truly grateful for the MHC—Meek and Lowly Bursary, as it has allowed me to embark on my journey of studying medicine without heavy financial burdens.

Mr Charles Yau Rong Zhang

Class of 2026

MHC - Meek & Lowly Bursary recipient



// It has been an amazing journey with Duke-NUS so far. Medical school is nothing like what I had imagined with so much technology available to help us learn subjects like anatomy. This, combined with doing actual cadaveric dissections, creates an eye-opening experience of the intricacies of the human body. Learning how to do physical examinations of different organ systems and understanding the signs of various disease pathologies have been a thought-provoking endeavour. It makes me think about how the smallest changes in the body could form very serious conditions with drastic consequences,

requiring future clinicians to be more observant and not to disregard patients' concerns, however small.

As an international student, my family and I are deeply grateful for the Dhun Nargolwala Bursary Award which provides a huge financial support to my four years of medical education in Singapore. I can't thank the donor enough for the bursary!

Mr Mukul Prasad

Class of 2026

Dhun Nargolwala Bursary recipient



// Studying at Duke-NUS has been a very invigorating and humbling experience so far. It is a joy and privilege to learn alongside the many driven and intelligent classmates under our tutors amidst the never-ending struggle to learn more about human diseases, develop my clinical skills, and understand patients and their circumstances, I've really come to appreciate that medicine is a lifelong craft.

And what a great privilege and responsibility it is to be a medical student and future doctor! I am grateful for the kind support offered to me by the scholarship, and hope to do it justice.

Ms Chia Pei Yun

Class of 2026

Shaw Foundation Scholarship recipient



It's been a busy and rewarding journey at Duke-NUS for the past two years. My first year was quite a handful as I had to balance my time between studying and being a father for the second time. Thankfully, my supportive team mates from Team 7 guided me along. Currently, I'm in the midst of doing my year-two clinical rotations in various hospitals and I have enjoyed learning from my patients and from my brilliant peers, and being part of a medical team that saves peoples' lives.

I am very honoured to be awarded the Kwan Im Thong Scholarship. This is a recognition of the effort and time I have put in, and the support that my family has given me. It also motivates me to continue to work hard and excel in my studies. I would like to express my heartfelt thanks to the donors. Thank you for your generosity which has eased the burden on my family. I am eternally grateful!

Mr Pierre Yim

Class of 2025

Kwan Im Thong Hood Cho Temple Scholarship recipient

New master's programme focusing on translating research into real-world solutions

To keep Singapore's medical research and innovation at the forefront, Duke-NUS partnered the Eureka Institute from Italy to launch a new programme—Master of International Translational Medicine, to strengthen the interdisciplinary branch of translational medicine.

A first-of-its-kind in Singapore, the interdisciplinary programme aims to bridge the gap between different areas of expertise not just within medicine but also between complementary

fields to empower researchers to develop faster, better medical treatments. For instance, connecting legislative and regulatory experts with medical researchers to facilitate bringing a newly-developed drug to market.

This programme, the latest addition to Duke-NUS' research-intensive offerings, offers opportunities for both academic and industry professionals to hone their skills and collaborate with experts from the Eureka network.

Shine at the National Medical Research Council Awards

Duke-NUS was established with a mission to train clinician-scientists who are not only competent in clinical skills but also passionate about advancing medicine through research.

A testament to the School's research-focused medical education, two PhD candidates from the Clinical and Translational Sciences Programme (CTS), a rigorous programme that admits clinicians and trains them

to lead multidisciplinary research in medicine, clinched their National Medical Research Council Clinician-Scientist Awards. They are Dr Liu Yu-Chi, an ophthalmologist from the Singapore National Eye Centre, and Dr Hairil Rizal, an anaesthesiologist from the Singapore General Hospital, who are from the inaugural and second cohorts of the CTS Programme, respectively.

Two Young Investigator Awards bagged

Two PhD candidates, Dr Nurul Jannah Binte Mohamed Nasir and Ms Allyson Choi, both from the Integrated Biology and Medicine Programme emerged as the newest Young Investigators at Duke-NUS.

For her research on wound healing in Associate Professor Lisa Tucker-Kellogg's lab, Dr Jannah received the prestigious Young Investigator Award at the Wound Healing Society at its Annual Meeting in Arizona in 2022. In her work, Dr Jannah focused on investigating the mechanisms that underlie poor wound healing and examining effective treatments. Dr Jannah successfully defended her thesis and was hooded in June 2023.

Ms Allyson Choi, a PhD candidate from Professor Ooi Eng Eong's research group, received the Young Investigator Award at the 2022 annual American Society of Tropical Medicine and Hygiene conference.

Focusing on elucidating molecular determinants of epidemiological fitness of dengue virus, Ms Choi received the award for her presentation on how a single nucleotide substitution within the pre-membrane protein successfully attenuated a strain of dengue virus serotype 2 during the course of the outbreak in the South Pacific Islands in the 1970s.



2022 was an exciting year for us. In January, we formally launched the Centre for Lifelong Learning (CLL) at Duke-NUS! With a new thrust of education initiatives now extending to working professionals, CLL provides an education hub, offering programmes developed at the SingHealth Duke-NUS Academic Medical Centre. These offerings are geared to enable healthcare professionals to upskill, innovate and lead, ultimately with the aim to optimise their impact on patients and the healthcare system.

The healthcare sector is oftentimes referred to as the Economy of Care, which is not only a vital and essential growth engine but also a constantly changing sector that needs to adapt to new care models, treatment options and technologies. Preparing for the manpower needed to support this growth necessitates filling the talent gaps and training professionals to take on new or expanding roles. In this context, CLL is offering NUS-accredited programmes in Health Services, Palliative Care, Innovation and Health Products Regulation.

Looking ahead, CLL will see a substantial expansion and we are excited to launch several new programmes with our partners. This includes the Graduate Certificate in Patient Safety and Quality Assurance, which includes an option to continue towards a Master in Patient Safety. Another new Graduate Certificate being offered will focus on Global Health with topics on infectious diseases, non-communicable diseases, and adolescent and planetary health. Building on the stackable approach of our courses, we are aiming to introduce a flexible Master's Programme in Health Services to provide our participants a pathway towards higher accreditation. Taken together, CLL strives to provide a valuable learning hub for professionals from healthcare, government, industry and academia for continuous studies and upskilling.



Associate Professor Silke Vogel

Head
Centre for Lifelong Learning

Nobel Prize Dialogue: Duke-NUS MD-PhD candidates join Nobel Prize laureates and global leaders to discuss the future of healthcare



Nobel laureate George Smoot (fourth from left) and Jacky Zhao (right most) during their panel on education and the future of youth.

Sharing a stage with Nobel Prize laureates to talk about the world's future is an experience that most students only dream of. Two of Duke-NUS' MD-PhD candidates—Mr Wharton Chan and Mr Jacky Zhao—were invited by Nobel Prize Outreach to do exactly that. On top of that, another Duke-NUS MD-PhD candidate—Mr Charles Tiu—was part of the organising committee for the event.

The Nobel Prize Dialogue, held in Singapore in September 2022, not only brought together Nobel Prize laureates, world-leading scientists, policymakers and thought leaders to discuss global issues, but also provided a special opportunity for young people to engage in these conversations.

In the panel 'Our digital future', Mr Wharton Chan, an MD-PhD candidate with Duke-NUS' Emerging Infectious Diseases Programme, joined Nobel Prize laureate Serge Haroche, recipient of the 2012 Nobel Prize in Physics, and four other panellists to talk about whether digital technologies enhance healthcare, the effect that artificial intelligence (AI) has across the globe and how to combat misinformation online.

Mr Chan said, "It was eye-opening to learn from both the laureate and other speakers. Laureate Haroche had great insights into how we should look at the harm done by AI and social media, while [the other panellists described] practical problems for weaving AI into our lives. It prompted me to think deeply about the role of technology in science and medicine and how the healthcare landscape will change in the future."

In the panel on 'Education and the future of youth', Mr Jacky Zhao, an MD-PhD candidate with Duke-NUS' Cancer and Stem Cell Biology Programme, shared his thoughts about tomorrow's education with the audience and his co-panellists, including Nobel Prize laureate George Smoot. They spoke on different aspects of gaps in education and how these could be addressed, equalising access to education, the importance of women's education globally and how the education sector is moving forward after the COVID-19 pandemic.

"Access to education is a basic human right, much like healthcare," said Mr Zhao. "While it provides a route for upward social mobility,

we need to avoid what Pierre Bourdieu described as the trap of elite reproduction via education. We need to reflect on the curricula, the assessments and lifelong learning—and discussions like the one that we had at the Nobel Prize Dialogue help to facilitate such forward planning.”

“I hope that more students will participate in such conversations, which are of importance to students not only in Singapore but also overseas,” said Mr Tiu, an MD-PhD candidate with Duke-NUS’ Emerging Infectious Diseases programme

and the first Duke-NUS President of Asian Medical Students’ Association (AMSA), Singapore.

“At AMSA Singapore, there’s a lot of overseas engagement, and we create discussions with guests and students from overseas. That’s a very important part of being a doctor because Singapore is a global city and—as future doctors and future leaders—we need to learn about problems existing across the world so that we can address them for a brighter and healthier future for all.”



(L-R): Nobel Prize Dialogue participants Mr Wharton Chan and Mr Jacky Zhao were joined by Mr Charles Tiu, who is the first president of the Asian Medical Students’ Association from Duke-NUS and part of the organising committee for the event.

Caring for our students

Duke-NUS promotes a nurturing and supportive environment for its students to achieve their full potential as future clinicians. This is made especially imperative in light of the recent pandemic, when cases of mental and emotional stress rose exponentially across the globe. In 2022, Student Affairs formalised the Student Wellbeing Strategies, an internal matrix that aims to solidify this support.

Student Affairs has also taken additional steps to ensure the students

remain well-connected with their peers and members of the faculty and staff. First-year students had individualised wellbeing check-ins with Student Affairs and faculty, to ensure they were settling in and acculturating well into Duke-NUS. All students received COVID-19 care-packs, and with the easing of Safe Management Measures, Student Affairs engaged faculty members and alumni to host festive meals for our international students who were unable to visit their families back in their home countries.



Professor Scott Compton, Associate Dean and Deputy Head of Office for Education (first from right in the second row), hosted a year-end celebration with students.

Student community service projects

With the easing of Safe Management Measures across the nation, Duke-NUS Doctor of Medicine (MD) students from the different years banded together to revive student community service projects, which provide students with platforms to give back to the community at large.

Hosting a successful blood donation drive

On 22 and 23 February 2022, students from Duke-NUS MD and MD-PhD cohorts rolled up their sleeves to help blood donors at the Bloodbank@HSA, as part of a blood donation drive that they had organised for the Duke-NUS community of students, staff and faculty.

The Duke-NUS student-organised donation drive was part of a larger effort of the TriMedSoc Alliance, which brings together the student bodies from Singapore's three medical schools. To ensure their project had the biggest impact possible, the organisers partnered another tertiary student-led organisation, Project Blood SG, which is a long-standing partnership between students and the Red Cross, to get the word out to the wider student community too.

More than 30 members of the Duke-NUS community headed to HSA's building on the SGH Campus to donate their blood.



The yearly blood donation drive organised by Duke-NUS students helps raise awareness of the blood donation process while boosting blood reserves for people in need.



The two-day camp provides an opportunity for children from cancer-afflicted families to learn new skills while having fun.

Camp Simba is back

On 25 and 26 June 2022, Duke-NUS collaborated with NUS Yong Loo Lin School of Medicine and NTU Lee Kong Chian School of Medicine to bring back Camp Simba, an annual camp for children from cancer-afflicted families that had been suspended for two years because of the pandemic.

Conceptualised as a joint project in 2009 by students from Duke-NUS and NUS Medicine, Camp Simba offers a safe emotional support system, enabling children to have fun while forging lifelong friendships.

Held at the NUS Kent Ridge campus, 30 children, aged between 9 to 16 years old, participated in the programme.

Equipping taxi drivers with CPR skills through Project CRANE

From 14 to 15 March 2022, Duke-NUS MD students participated in Project CRANE, a community service endeavour organised in close collaboration with the Singapore Red Cross and National Taxi Association. The programme consisted of health education talks delivered via Zoom that focused on diabetes management and urinary incontinence, as well as Dispatcher-Assisted first Responder (DARE) programme. The half-day training workshop served to equip local taxi drivers with essential CPR skills.



Project CRANE was developed by the Class of 2023 during their second year to promote general wellbeing and improve health literacy among marginalised groups.

An engaging dialogue session with Minister Ong Ye Kung

After an almost two-year hiatus, the highly anticipated Duke-NUS Dialogue was back! On 23 September 2022, the 8th Duke-NUS Dialogue was organised by the Duke-NUS Medical Alumni, the School's Alumni Association.

Graciously hosted by Duke-NUS founding Governing Board Chairman Mr Tony Chew and his family, the signature event was attended by

esteemed guests, including Health Minister Mr Ong Ye Kung, Duke-NUS senior management, faculty, students and alumni.

Since its inception in 2017, the Duke-NUS Dialogue initiative helps connect alumni to Duke-NUS' core mission, through regular dialogues with prominent clinicians, top scientific researchers and government leaders.



Health Minister Mr Ong Ye Kung (centre in the front row) was joined by Duke-NUS leaders, faculty and alumni at the Duke-NUS Dialogue.

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// Innovation requires you to sometimes abandon all the bells and whistles, and really go into the essence of what is needed and what is necessary. //

**Clinical Associate Professor
Tan Hiang Khoo**

Director
SingHealth Duke-NUS Global Health Institute
Deputy CEO (Future Health System)
Singapore General Hospital



Innovation: Equalising access to medicine

Duke-NUS' leadership in growing academic medicine through the SingHealth Duke-NUS Academic Medical Centre (AMC) has enabled the School to make great strides in advancing bench-to-bedside innovations. By combining cutting-edge research and clinical experience, clinician-innovators from the AMC are not only tackling the most pressing healthcare challenges with ground-breaking technologies, but also improving patient care with innovative and practical solutions.

Among these clinician-innovators is Clinical Associate Professor Tan Hiang Khoon, Director of the SingHealth Duke-NUS Global Health Institute and Deputy CEO (Future Health System) of Singapore General Hospital, who co-leads a collaboration with Professor Walter Lee from Duke University, on using frugal innovation and artificial intelligence (AI) for head and neck cancer screening. The research, supported by a Duke/Duke-NUS Research Collaboration Pilot Project Grant zeroes in on flexible nasal scopes, which are essential for head and neck surgeons to diagnose cancer.

"By using AI, we can generate an algorithm that acts as an assistive tool," shared Clin Assoc Prof Tan. "That means it will flag anomalies and help doctors make the correct diagnosis and decision on when to refer a patient."

Another key feature of this innovation is that it can significantly reduce the cost of screening for nose cancers, which are common in Asia.

"[Traditional] scopes cost generally between US\$8,000 to US\$12,000 per scope, which is frankly out of the affordability of many countries in the region," explained Clin Assoc Prof Tan. "If we could make a reusable scope that could be used 500 times

for US\$500, that would average out to US\$1 per use."

With a pilot grant from Duke-NUS and Duke, Clin Assoc Prof Tan and his collaborators designed a nasal scope with an affordable price point, helping to address the gap in the early detection of nose cancers. This project has since secured a US\$3 million RO1 grant from the US National Institutes of Health that includes a field implementation phase to enable nose cancer screening of at-risk populations.

In sharing his experience as a seasoned clinician-innovator, Clin Assoc Prof Tan reflected that while intellectual property is important in bringing an idea to the market, innovators should focus on tackling pressing, real-world problems first.

"When we get together to address something like this, something that requires frugal solutions, what's critically important is our passion for innovation. Our calling as an AMC is to always push the frontier of knowledge," he said.

While AI is a key enabler of this particular project that offers great potential for other clinical applications and treatments, Clin Assoc Prof Tan stressed the need to build a robust ecosystem for rolling out this tool.

"AI growth is exponential, but users don't progress in the same way. For us to realise the full potential of AI, some thinking has to be done about how we help people adapt to this very rapidly changing environment," Clin Assoc Prof Tan pointed out. "You need to train people, have a system to make it work, and a network of collaborators that can feed into the value of the system."

"I cannot think of a better place than Duke-NUS for this to happen."

Inducting second cohort of outstanding clinicians into Hall of Master Academic Clinicians



Watch the highlight video of the event here.

Eight exceptional clinicians were inducted into Duke-NUS' prestigious Hall of Master Academic Clinicians—the School's highest recognition for outstanding clinical faculty—at a hybrid event held on 25 February 2022.

This is the second cohort of clinical faculty to be inducted into the Hall. The inaugural cohort was inducted in a ceremony in January 2021.

The eight newest inductees represent seven of the 15 SingHealth Duke-NUS Academic Clinical Programmes (ACPs), which were established for each clinical specialty to facilitate residency

training for Duke-NUS students upon graduation. The 2022 inductees came from Singapore General Hospital, Sengkang General Hospital, KK Women's and Children's Hospital, National Dental Centre Singapore, National Heart Centre Singapore and SingHealth Polyclinics.

The Hall of Master Academic Clinicians celebrates outstanding clinicians who train and mentor medical students and young clinicians, and pursue academic excellence to improve the lives of patients in Singapore and beyond. The Hall is one of several ways in which Duke-NUS recognises its clinical faculty.



The eight newly inducted Master Academic Clinicians are an inspiration to all on the academic medical campus.

Duke-NUS celebrates its pioneer clinical faculty

More than 50 senior clinical faculty members from the SingHealth Duke-NUS Academic Medical Centre (AMC) were promoted or appointed to the ranks of associate or full professor in 2022.

First, in February 2022, the campus celebrated the promotion or appointment of 30 senior clinical faculty members during the Hall of Master Academic Clinician induction ceremony.

On 27 July 2022, another 21 senior clinical faculty were promoted or appointed to full or associate professorships. During the same celebrations, the School also recognised its very own pioneer clinicians who have served Duke-NUS since its inception: 13 clinical faculty members received their 15-year long service award.

For many of them, joining this new venture was both a “leap of faith” as well as a chance to shape a new medical curriculum and School culture—in other words, a once-in-a-lifetime opportunity.

Thanking the School’s clinical faculty for their commitment to academic medicine, Duke-NUS Dean Professor Thomas Coffman commended them for their contribution to “our successes to becoming a world-class AMC”.

“I want to thank them for their courage and their conviction,” added Clinical Associate Professor Chow Wan Cheng, Vice-Dean for Academic and Clinical Development, who hoped that the newly promoted and appointed faculty would, in turn, inspire and mentor the next generation to reach even greater heights.



The 15-year long service award recipients gather for a commemorative photo with Clinical Associate Professor Chow Wan Cheng (front, centre) as well as Senior Vice-Dean for Corporate Services Ms Karen Chang (second left) and Vice-Dean for Education Professor Ian Curran (right).

Recognised at the 2022 National Medical Excellence Awards



Professor Marcus Ong has improved the lives of patients in areas such as out-of-hospital cardiac arrest and pre-hospital emergency care.

National Outstanding Clinician-Scientist Award

For his contributions to pre-hospital emergency care and services, Professor Marcus Ong received the National Outstanding Clinician-Scientist Award at the 2022 National Medical Excellence Awards.

Prof Ong has dedicated much of his career as a clinician-scientist to improving the lives of patients, focusing on areas such as out-of-hospital cardiac arrest (OHCA), and pre-hospital emergency care.

As a senior consultant at the Department of Emergency Medicine at the Singapore General Hospital, Prof Ong has spearheaded numerous initiatives that have led to a 10-fold improvement in the survival rate for OHCA.



As a clinician-educator, Clinical Professor Chan Choong Meng's life-long passion lies in imparting his skills and experience to younger colleagues. Photo: SingHealth

National Outstanding Clinician-Educator Award

Clinical Professor Chan Choong Meng, Senior Associate Dean in the Office of Education at Duke-NUS, was named National Outstanding Clinician-Educator in recognition of his outstanding contributions to the education and training of clinicians and healthcare staff, and his exemplary support in developing skills and competencies to uphold high standards of care and treatment.

During COVID-19, Prof Chan worked with various stakeholders to ensure safe resumption of essential clinical training, as well as assessments for students.

He also leveraged the use of gamification and immersive media technologies by working with the Graduate Medical Education Office at SingHealth Academy and SingHealth Duke-NUS Institute of Medical Simulation to develop the resources and infrastructure to support virtual lessons.



Duke-NUS Clinical Associate Professor Ng Kee Chong received the National Outstanding Clinician-Mentor Award. Photo: KK Women's and Children's Hospital

National Outstanding Clinician-Mentor Award

Duke-NUS Clinical Associate Professor Ng Kee Chong received the National Outstanding Clinician-Mentor Award for his dedication and service to paediatric emergency medicine, his contributions to advancing clinical education in maternal and child health, and his leadership during previous pandemics and disease outbreaks including SARS, H1N1, Zika and COVID-19.

He was the first paediatrician in Singapore to practise paediatric emergency medicine and has championed an approach built around the health of the mother, child and family. He has been instrumental in setting up the SingHealth Duke-NUS Maternal and Child Health Research Institute and supported key initiatives that improved the health of infants and children.



The CHAT team featuring (L-R): Dr Charmaine Tang Yu Zheng, Ms Chloe Ang Choo Eng, Associate Professor Swapna Kamal Verma and Ms Lee Yi Ping. Photo: Institute of Mental Health

National Clinical Excellence Team

The CHAT team

The National Clinical Excellence Team award was presented to the CHAT team from the Institute of Mental Health for delivering high-quality services to distressed young people by improving their access to care. Since its inception in 2009, CHAT has become the “go-to” resource for youth mental health information, professional support, training and collaboration in advocacy work. The CHAT team is led by Duke-NUS Associate Professor Swapna Kamal Verma, Chairman of IMH’s Medical Board and Programme Director for CHAT. She is joined by Dr Charmaine Tang Yu Zheng, Chief at IMH’s Department of Psychosis and Deputy Programme Director of CHAT; Ms Lee Yi Ping, Principal Case Manager for CHAT, and Ms Chloe Ang Choo Eng, Manager at IMH’s Department of Psychosis & CHAT.



The CareLine team featuring (L-R): Mr Eric Chen, Ms Pearlina Lee, Ms Claudia Ma and team lead, Adjunct Associate Professor Eugene Shum. Photo: Changi General Hospital

The CareLine team

A team from Changi General Hospital (CGH) and the Agency for Integrated Care also received a National Clinical Excellence Team award for their innovative telecare ecosystem that supports senior citizens to live and age well in the community. Called CareLine, this 24/7 personal care telephone service was pioneered by CGH for vulnerable older people in need of urgent assistance. It helps to keep particularly those who may be living alone or are frail stay safe and healthy at home and in the community. The CareLine team comprises adjunct Associate Professor Eugene Shum, Chief Community Development Officer at CGH; Ms Pearlina Lee, Deputy Director of Home Care and Safety at CGH; her colleague Claudia Ma, a senior executive in the Home Care and Safety team; as well as Mr Eric Chen, Director of Operations at the Silver Generation Office at the Agency for Integrated Care.

Recognition for mentees at the Centre for Clinician-Scientist Development

On 30 September 2022, the Centre for Clinician-Scientist Development (CCSD) celebrated the achievements of mentees who received the Ministry of Health's National Medical Research Council (NMRC) Transition Awards and first-time Clinician-Scientist Awards.

A total of 18 NMRC awardees were honoured at the event. This was almost twice as many awardees than in previous grant calls, making it a particularly proud moment for the CCSD team. The team had supported most of the recipients while they participated in the Centre's various programmes.



L-R: Associate Professor Darren Lim, Principal Lead Mentor for Clinician-Scientists; Professor Roger Vaughan; Associate Professor Deidre De Silva, Principal Lead Mentor for Clinician-Investigators; and Associate Professor Derrick Chan, Principal Lead Mentor for Clinician-Innovators at the fireside chat moderated by Prof Vaughan.



The Centre for Clinician-Scientist Development (CCSD) continues to support budding clinician-scientists across the SingHealth Duke-NUS Academic Medical Centre (AMC). We celebrated 18 National Medical Research Council grant awardees in 2022, bagged six Clinician-Scientist Awards, three Health Promotion, Preventive Health, Population Health and Health Services Research Clinician Scientist Awards, two Clinician-Innovator Awards, and seven Transition Awards!

Four keys unlocked this success for us:

First, we have assembled a dedicated team comprising senior clinician-scientists including Professor Derrick Robinson who serves as our anchor mentor, as well as Associate Professors Darren Lim, Deidre Anne De Silva and Derrick Chan who provide leadership to the development of our clinician-scientists, clinician-investigators and clinician-innovators. Holding it all together are seasoned managers Ms Fion Farn, Ms Angie Tan, and Ms Meixuan Chen.

Second, we continue to identify and work with the right constituent groups across the clinician-scientist life course and engage with them as appropriate to maximise their opportunities, from instilling early awareness among medical students, to mentoring MD/PhD students in their research, to working with early-stage clinicians to incorporate research into their careers, and meeting with experienced investigators who may need refreshers on methods or grantsmanship.

Third, identifying potential clinician-scientists across the AMC means three things: outreach, outreach and outreach. We have made a concerted effort to ensure that we appear in front of each Academic Clinical Programme (ACP) to enlist their help to identify faculty with the potential and interest to grow into clinician-scientists.

Finally, once identified, potential clinician-scientists are enrolled in CCSD, starting with a five-year Individual Development Plan. We then provide the right next steps to maximise their success through programmes that help to refine their specific aims, assist in overall grant writing, biostatistics and research design, analytic support and post-award guidance.

We will continue to support clinician-scientists and look forward to another successful year!



Professor Roger Vaughan

Director
Centre for Clinician Scientist Development

Emerging from the pandemic stronger and better: The Academic Medicine Advisory Council Meeting 2022

From 25 to 28 October 2022, the SingHealth Duke-NUS Academic Medical Centre (AMC) was abuzz with activity as the long-awaited fifth Academic Medicine Advisory Council (AMAC) gathered in-person at The Ngee Ann Kongsi Auditorium. Through the bi-annual meeting, AMAC reviews the AMC's progress, shares best practices and insights, and develops a set of recommendations on the way forward.

The four-day event was kicked off by Duke-NUS Dean Professor Thomas Coffman and SingHealth Group CEO Professor Ivy Ng who welcomed the

AMAC members as well as the many participants from across the campus.

As the programme unfolded, the Council engaged in insightful dialogues and tea sessions with various stakeholders from the AMC. Their discussions centred on three main themes: population health in an ageing population, healthcare innovation and the importance of interdisciplinary partnerships.

This year, the AMAC panel welcomed three new members—Professor Gillian Harvey, Flinders University; Professor Margaret Chan, Founding Dean



Joining the dialogue session on the first day of AMAC 2022 are (L-R): Professor Sam Hawgood, Professor Victor Dzau, Professor Ivy Ng, Professor Sir Keith Peters, Duke-NUS Dean Professor Thomas Coffman, Professor Arthur Rubenstein and Professor Gillian Harvey. Photo: SingHealth



(L-R) Professor Ivy Ng watches on as Professor Thomas Coffman thanked the AMAC council for their recommendations in his closing remarks.

of Vanke School of Public Health, Tsinghua University; and Professor Victor Dzau, President of the National Academy of Medicine—who joined AMAC Chairman Emeritus Regius Professor Sir Keith Peters, University of Cambridge, and members Professor Arthur Rubenstein, University of Pennsylvania, and Professor Sam Hawgood, Chancellor of the University of California San Francisco.

Another highlight was the ‘Academic Hour with AMAC’ segment, a series of keynote lectures by AMAC members. The audience heard from Prof Dzau, Prof Hawgood and Prof Harvey who shared their insights on pertinent issues relating to population health, interdisciplinary collaboration, and strategies for innovation and implementation.

On the last day, Prof Chan, who used to head the World Health Organisation, addressed the audience about the importance of a coordinated response in tackling the global emergency of non-communicable diseases.

In his closing remarks, Sir Keith congratulated the entire AMC community on its progress, noting that the rate at which things have improved and the way the AMC leadership has taken the panel’s previous recommendations are “quite extraordinary”.

Prof Coffman added that it had been a phenomenal week and thanked the Council for their recommendations, emphasising that they had been incredibly helpful in charting the AMC’s path. Echoing his sentiments, Prof Ng also expressed her gratitude to the Duke-NUS and SingHealth Governing Boards, co-chairs of the AMAC 2022 Organising Committee Clinical Associate Professor Adrian Koh and Professor Nicholas Graves as well as Vice-Dean for Academic and Clinical Development Clinical Associate Professor Chow Wan Cheng for a successful AMAC 2022.

With the conclusion of AMAC 2022, a new chapter at the SingHealth Duke-NUS AMC begins as plans are laid to follow through on the AMAC’s latest recommendations before the next meeting in two years’ time.

Bringing the World One Health Congress to Singapore

The 7th World One Health Congress (WOHC), the world's premier event to advance the One Health agenda, was held between 7 and 11 November 2022, at the Sands Expo & Convention Centre in Singapore with more than 1,400 in-person and 1,000 virtual attendees from academic institutions, civil society, government bodies, private sector and multilateral organisations around the world.

Mdm Halimah Jacob, President of the Republic of Singapore, graced the opening ceremony as its Guest-of-Honour and delivered a speech.

The five-day Congress, hosted by the SingHealth Duke-NUS Global Health Institute under the auspices of the SingHealth Duke-NUS Academic Medical Centre, is themed 'Integrating science, policy and clinical practice: A one health imperative post-COVID-19'. It sought to advance the global One Health movement to improve health and wellbeing by preventing and mitigating crises that originate at the animal-human-environment interface.

With Temasek Foundation as the Pinnacle Sponsor, this was the first WOHC to take place in person after the COVID-19 outbreak, providing a pivotal platform for promoting multisectoral efforts and collaboration.

At the Opening Ceremony, Dr Tedros Adhanom Ghebreyesus, Director-General of the World Health Organisation, delivered opening remarks virtually, followed by Dr Monique Eloit, Director-General of the World Organisation for Animal Health, who, with her remarks, marked the commencement of a curated programme of keynote speeches, plenary lectures, scientific sessions with abstract presentations and panel discussions on urgent and emerging One Health topics.

The Congress saw more than 120 speakers from more than 60 countries share their learnings and insights across diverse disciplines, including representatives from agencies such as the Food and Agriculture Organisation of the United Nations, the United Nations Environment Programme, and the World Bank. Key highlights included a panel discussion on 'Operationalisation, system coordination and science-policy linkage', as well as a keynote address on 'Catalytic philanthropy and its role in pandemic preparedness' by Dr Chris Elias, President of the Global Development Division, Bill & Melinda Gates Foundation.



Mdm Halimah Yacob, President of Singapore, speaking at the opening ceremony of the World One Health Congress.



We must work together, not only when a crisis unfolds, but strive to be ahead of the curve through strong collaborations and preparations, even during peacetime.

It is only by working collectively that we can secure the health of this generation and the next. I am confident this Congress will pave the way for many exciting collaborations which can lead to new solutions and better outcomes for health.”

Mdm Halimah Yacob
President of Singapore

OFFICE OF INNOVATION AND ENTREPRENEURSHIP

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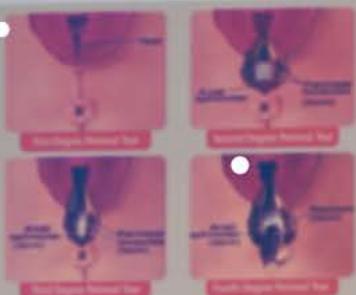
GROUND

10% of pregnancies, up to 10 to 20 pregnancies affected

occurrences at term, occur when the baby's head is not engaged in the pelvis or cannot progress in the pelvis

and head of the baby, occur without requiring delivery

Causes



There is fourth degree tears, also known as obstetric anal sphincter injuries (OASIS), which may be caused by forceps or vacuum-assisted delivery and from vaginal tear that occur in an episiotomy. The consequences of perineal trauma include pain, infection, urinary incontinence, fecal incontinence, pelvic incontinence, pelvic floor dysfunction and sexual dysfunction.

- Signs and symptoms include physical and mental trauma.
- Pain, floor dysfunction
 - Urinary, fecal incontinence
 - Pelvic floor dysfunction
 - Sexual dysfunction



TECHNOLOGY

Low cost solution to reduce the incidence of medications to ensure safe tears during vaginal deliveries



STATEMENT

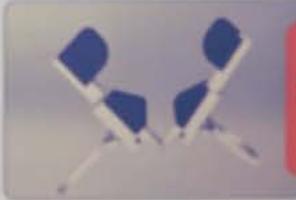
Low cost solution to reduce the incidence of medications to ensure safe tears during vaginal deliveries

TYPE: OASIGUARD

Low cost solution to reduce the incidence of medications to ensure safe tears during vaginal deliveries



OUR SOLUTION



A cushioned ergonomic pressure redistribution lead for tear-free vaginal deliveries

Comparison to many different and expensive

Device	Material	Weight	Price	Use	Storage
OASIGuard	Soft foam	Light	Low	Easy	Compact
Other Device 1	Hard plastic	Heavy	High	Difficult	Bulky
Other Device 2	Hard plastic	Heavy	High	Difficult	Bulky
Other Device 3	Hard plastic	Heavy	High	Difficult	Bulky
Other Device 4	Hard plastic	Heavy	High	Difficult	Bulky
Other Device 5	Hard plastic	Heavy	High	Difficult	Bulky

MARKET POTENTIAL:

Global market for OASIS treatment is projected to reach \$1.2 billion by 2025. The market is currently dominated by high-cost, low-quality products. OASIGuard offers a low-cost, high-quality solution that is easy to use and store. The device is made of soft foam and is lightweight, making it easy to transport and use in various settings. The device is also easy to clean and maintain. The market is growing rapidly due to the increasing incidence of OASIS and the need for effective treatment. OASIGuard is a leading solution in this market.

TEAM FEMTECH



// Commercial discovery is all about understanding the market. Analysing the market was completely new to me because I was not business-minded. So, I really had to start thinking about those numbers to establish an understanding of the current need and future potential of our solution. //

Ms Gayathri Ramalakshmi
Third-year medical student



Addressing clinical needs through new inventions

Innovation and entrepreneurship are Duke-NUS' hallmarks. Whether they are scientific breakthroughs that enable new clinical applications, or procedural improvements that enhance the patient experience and outcomes, they are critical to advancing the School's vision of transforming medicine and improving lives.

The Duke-NUS Health Innovator Programme is the School's latest initiative to nurture an innovation-driven mindset in Duke-NUS students so they will continue to improve clinical practice after they graduate.

Ms Gayathri Ramalakshmi is one of nine students who enrolled in the Programme's first cohort. Split into three teams, the students, under the guidance of clinical mentors and business partners, focused on innovations in women's health. "Commercial discovery is all about understanding the market—its needs, size and potential," said Ms Gayathri. "Everything was completely new to me because I am not business-minded. So, I really had to start thinking about those numbers beyond science and medicine."

The Health Innovator Programme teams up third-year medical students from Duke-NUS with peers from the National University of Singapore's engineering and business programmes to work on a project that addresses an unmet clinical need.

Describing her team's work to develop a method to enhance embryo transfer and decrease operator dependence during the final step of in-vitro fertilisation (IVF), Ms Gayathri said, "It's a very high-stakes procedure as for a couple to reach this step, they

usually would have gone through countless treatments, anxiety, side effects of medications and spent a lot of money."

"But the reality is that 70 per cent of embryo transfers fail," Ms Gayathri added. "Everything patients have invested up to this moment has got only a 30 per cent chance of success. So, we are trying to address that with an improved catheter."

The current embryo transfer technology has not changed much in the last 40 years. "Our product has the potential to solve many pain points that fertility patients go through, such as discomfort and long procedure time. Ultimately, we hope it will improve clinical pregnancy rates," said Ms Gayathri.

Ms Gayathri also cited how instrumental her mentors – Mr Prusothman Raja, co-founder of Twoplus Fertility, and Dr Wong Ker Yi from KK Women's and Children's Hospital – have been.

"By allowing us to observe procedures in the operating theatre, Dr Wong made sure we fully understood the problem, which is essential to address any issue or build any product," Ms Gayathri recounted, "whereas Mr Raja shared a lot of insight in terms of how the industry works and the complex regulation for this medical industry."

"And the best part of the programme is that our invention may continue beyond the completion of the programme and our journey at Duke-NUS," Ms Gayathri said. "Not only were we able to file provisional patents for our projects, we also have opportunities to advance our inventions into clinical trials, turning our ideas into a reality."

New programme to nurture next generation of clinician-innovators at Duke-NUS

Singapore's status as a thriving global innovation node received a boost with the launch of a new programme that will spark an innovation-driven mindset in the next generation of clinicians, engineers and entrepreneurs.

Hosted at Duke-NUS, the new Health Innovator Programme provides an immersive experience for third-year medical students who are teamed up with peers from the National University of Singapore's engineering and business programmes, and mentored by clinicians and industry partners. The inaugural cohort comprises nine

students who will focus on innovations in women's health.

Underlining the School's commitment to innovation, Dean Professor Thomas Coffman commented that this programme will help "bring discoveries from the imaginations of scientists and inventors into the public domain where they can improve lives." Discoveries that he hopes will stand alongside innovations such as cPass™, the first FDA-authorized surrogate virus neutralisation test, and exciting therapies and potential cures for diseases such as fibrosis and cancer that are being developed by scientists at Duke-NUS.



Professor Thomas Coffman (centre left) and Mr Goh Yew Lin (centre right) talk to students about innovation during a networking session held after the launch.



Duke-NUS Dean Professor Thomas Coffman, Duke-NUS Senior Vice-Dean for Corporate Services Ms Karen Chang, Assistant Professor Rena Dharmawan and Duke-NUS Governing Board Chairman Mr Goh Yew Lin at the launch of the Health Innovator Programme, a new programme developed by Asst Prof Dharmawan that aims to spark an innovation-driven mindset in students.

Held at the Amphitheatre at Duke-NUS on 22 September, the launch—like the programme—brought together stakeholders from the innovation ecosystem, including innovation champions like Professor Dean Ho from NUS, representatives from industry such as Enterprise Singapore and startups like Vivo Surgical as well as clinician mentors from SingHealth.

During a panel discussion at the launch, four students from the

inaugural cohort talked about their projects, what had prompted them to apply for this programme, their experience so far and the challenges they faced. With topics ranging from in-vitro fertilisation to fibroid surgery and prenatal ultrasound technology, the students, with the guidance of their industry partners and clinical mentors, went on to invent solutions and develop prototypes before presenting their projects at a Shark Tank-style presentation.

Duke-NUS, Johnson & Johnson join hands to advance dengue innovation through a new discovery centre



Duke-NUS scientists sharing a research update at the Centre with Dr Ruxandra Draghia-Akli (top picture, right), Global Head of J&J's Global Public Health R&D, and other delegates from J&J (below).

Duke-NUS and Johnson & Johnson (J&J), the world's largest healthcare company, today jointly launched a new J&J Satellite Centre for Global Health Discovery to drive solutions that will mitigate the threat posed by flaviviruses such as dengue and Zika.

The first of the J&J Centres for Global Health Discovery in the Asia-Pacific region, the Satellite Centre at Duke-NUS marks the latest effort of the SingHealth Duke-NUS Academic Medical Centre (AMC) to develop a collaborative Discovery District on its campus to advance bench-to-bedside research. It builds on the longstanding collaboration between Duke-NUS and the Janssen Pharmaceutical Companies of J&J, bringing together Duke-NUS' expertise in research and translational commercialisation with J&J's deep industry experience to accelerate discovery research against flavivirus-related diseases and improve lives.

Flaviviruses, like dengue and Zika, cause significant illness and death, yet no specific antiviral therapeutics are currently available. By uniting expertise from across the scientific community, the Satellite Centre at Duke-NUS will strengthen Singapore's standing as a hub of discovery research to tackle flaviviruses, which infect more than 400 million people each year, putting half of the global population at risk. In particular, Asia bears nearly three-quarters of the global burden. Billions more could be impacted in the coming decades as the animal vectors that carry flaviviruses venture beyond the

tropical regions where they have traditionally thrived, spreading the diseases to new areas.

Building a thriving Discovery District on campus

The establishment of the Satellite Centre at Duke-NUS is part of the continued commitment by both Duke-NUS and the School's academic medicine partner SingHealth to build a Discovery District on the AMC campus. In attracting local and overseas innovation partners to co-locate on the campus, the Discovery District fosters collaborations between the AMC and its industry partners while achieving synergy through a vibrant ecosystem of education, research, clinical expertise and commercialisation.

Research at the Satellite Centre at Duke-NUS is already underway, led by Professor Subhash Vasudevan, Emerging Infectious Diseases Programme, Duke-NUS, and his counterpart over at J&J.

The Emerging Infectious Diseases Programme at Duke-NUS has been at the forefront of tackling the most pressing healthcare challenges faced by Singapore and the region. Most recently, the School played a critical role in driving progress to tackle dengue by working with SingHealth's Investigational Medicine Unit to conduct a Phase IIa clinical trial evaluating Janssen's antiviral compound for the prevention and treatment of dengue.



During the panel discussion commemorating the launch of the Centre, Duke-NUS scientists and their collaborators share their views on the urgency of translating science into solutions to address healthcare challenges.

Attracting more biomed startups to open innovation centres

Two more biomedical companies—PrinterPrezz and Paratus Sciences—now call the SingHealth Duke-NUS Discovery District home.

For PrinterPrezz, setting up a physical presence at the SingHealth Duke-NUS AMC, provides the company access to the academic community, enabling it to establish a “beachhead” in Singapore while continuing to leverage its US capabilities, and ultimately grow its Asia operations.

The other start-up, Paratus Sciences, also set up a laboratory at Academia, making it the first in the Discovery District’s Inflammation and Infectious Diseases Hub. Headquartered in New York, the start-up will invest in collaborative research in potential treatments for immune and inflammatory diseases with Duke-NUS scientists.



Together with our academic medicine partner SingHealth and industry collaborators, Duke-NUS is building a thriving Discovery District on campus to accelerate innovation and bench-to-bedside translation.

Bolstering innovation with a pipeline of intellectual properties



Assistant Professor David Wang

Director
Centre for Technology and Development



The Centre for Technology and Development (CTeD) continued to make remarkable progress on many fronts in 2022, from increasing outreach to scientists and clinician-scientists across the SingHealth Duke-NUS Academic Medical Centre to expanding Duke-NUS technology commercialisation portfolio.

Last year also marks another fruitful one, fuelling our efforts in bench-to bedside translation to address the health challenges faced by the region and the world through partnerships with industry.

For instance, the exclusive worldwide licensing agreement signed between Duke-NUS and Singapore start-up CoV Biotechnology to develop broad-spectrum vaccines and therapeutic antibodies could potentially protect the world's population from future coronavirus pandemics.

Beyond the region, we inked two exclusive licence agreements with Alder Therapeutics from Sweden to develop innovative cell therapies for retinal and cardiac diseases. We also signed an exclusive licence agreement with a US start-up Paratus Sciences to develop pioneering anti-inflammation therapies.

In an effort to expand Duke-NUS' commercialisation portfolio and technology offerings, we completed two biological material licences with Applied Biological Materials, Inc. and BioLegend Inc.

Looking forward, CTeD strives to continue driving the School's cutting-edge research into real-world applications. We will do so by introducing programmes and enhancing funding support to further spur an innovative spirit at Duke-NUS, cementing the School's position as a powerhouse in biomedical research and innovation.



Duke-NUS partners Singapore start-up CoVBio to develop broad-spectrum COVID-19 vaccines and therapeutics

Duke-NUS has signed an exclusive worldwide licensing agreement with Singapore start-up CoV Biotechnology (CoVBio) to develop broad-spectrum vaccines and therapeutic antibodies that could potentially protect the world's population from future coronavirus pandemics.

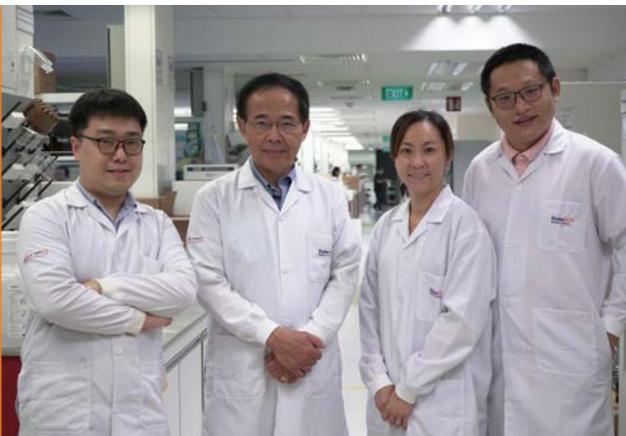
Taking this game-changing medical technology a step closer to reality, a novel consensus sequence has been designed to develop vaccine candidates that target not only SARS-CoV-2 and its currently circulating variants of concern (VOCs), but also future VOCs, as well as animal coronaviruses that have the potential of infecting humans—a group of respiratory viruses collectively known as sarbecoviruses.

CoVBio— co-founded by investment firms ClavystBio and Polaris Partners— will bring to market a discovery made by Professor Wang Linfa and his team from Duke-NUS' Emerging Infectious Diseases Programme. Their findings, published in the *New England Journal of Medicine* in 2021, showed that 2003 SARS survivors who were vaccinated with the Pfizer-BioNTech mRNA vaccine produced very powerful antibodies capable of neutralising known SARS-CoV-2 VOCs and animal sarbecoviruses.

Sarbecoviruses rely on binding to the ACE2 protein to infect cells. Both SARS-CoV-1 and SARS-CoV-2, as well as a number of coronaviruses circulating in animals such as bats, pangolins and civets, belong to this group.

In exploring the possibility of inducing pan-sarbecovirus neutralising antibodies to block the interaction between the virus and the ACE2 protein, the team has designed a consensus sequence called C1.25 which has been used to produce mRNA and protein subunit vaccine candidates against all SARS-CoV-2 VOCs.

Besides developing the pan-sarbecovirus mRNA and protein subunit vaccines, Duke-NUS and CoVBio will also be co-developing broad-spectrum therapeutic antibodies as part of this partnership, which will offer additional treatment options for people suffering from severe disease.



Duke-NUS Professor Wang Linfa (second from right) and his team from the School's Emerging Infectious Diseases Programme are developing broad-spectrum vaccines and therapeutics against the SARS-CoV-2.

Partnership with Alder Therapeutics to boost cell-based regenerative therapy

In a boost to regenerative therapies for damaged hearts and eyes, Duke-NUS has licensed two laminin-related patents to Swedish biotech start-up Alder Therapeutics to enhance the development of Alder's retinal and cardiac cell therapeutic products.

Both licences originate from discoveries made by Professor Karl Tryggvason from Duke-NUS' Cardiovascular and Metabolic Disorders Programme, who discovered that the laminin family of proteins can direct stem cell differentiation. Using highly cell-type-specific laminins, Prof Tryggvason and his team are now capable of developing fully humanised, chemically defined, reproducible and non-tumourigenic differentiation protocols for making several cell types derived from human embryonic stem cells.



Both licences originate from discoveries made by Professor Karl Tryggvason from Duke-NUS' Cardiovascular and Metabolic Disorders Programme, who discovered that the laminin family of proteins can direct stem cell differentiation.

One of the two inventions being advanced to clinical application by Alder is based on the retinal cell research led by Assistant Professor Tay Hwee Goon from Duke-NUS' Centre for Vision Research. With the ability to produce two previously unavailable retina-specific laminins—LN-523 and LN-323—the team has developed a method to influence human embryonic stem cells to differentiate into photoreceptors, presenting an effective treatment option that may benefit patients who have lost their vision due to retinal degeneration. The team demonstrated that after the cells were engrafted, they prevented further damage to the retina and improved visual function in preclinical studies.

The other technology licensed to Alder for therapeutic development is a novel protocol to generate heart muscle precursors, called cardiomyocyte progenitors, from human embryonic stem cells. Using this technology, the team can generate these precursors from human embryonic stem cells in 9 to 11 days using laminin, LN-221, a protein that is abundantly present in heart muscles. In preclinical tests, the team observed an increase in heart function and lack of tumour formation, paving the way for a safe and effective way to regenerate human heart muscle.



Watch the video for more events and updates of Duke-NUS in 2022.

Duke-NUS facts and figures at a glance

All information accurate as of 31 Dec 2022, unless stated otherwise.

STUDENTS' PUBLICATIONS AND PRESENTATIONS OF EACH CLASS	STUDENTS' ACADEMIC BACKGROUND	DIVERSITY IN OUR STUDENT BODY																																													
<table border="1"> <caption>Students' Publications and Presentations of Each Class</caption> <thead> <tr> <th>Year</th> <th>Publications</th> <th>Presentations</th> </tr> </thead> <tbody> <tr><td>2011</td><td>30</td><td>45</td></tr> <tr><td>2012</td><td>40</td><td>53</td></tr> <tr><td>2013</td><td>27</td><td>53</td></tr> <tr><td>2014</td><td>57</td><td>62</td></tr> <tr><td>2015</td><td>43</td><td>99</td></tr> <tr><td>2016</td><td>37</td><td>74</td></tr> <tr><td>2017</td><td>58</td><td>61</td></tr> <tr><td>2018</td><td>49</td><td>60</td></tr> <tr><td>2019</td><td>38</td><td>57</td></tr> <tr><td>2020</td><td>75</td><td>100</td></tr> <tr><td>2021</td><td>35</td><td>45</td></tr> <tr><td>2022</td><td>25</td><td>21</td></tr> <tr><td>2023</td><td>15</td><td>21</td></tr> <tr><td>2024</td><td>1</td><td>1</td></tr> </tbody> </table>	Year	Publications	Presentations	2011	30	45	2012	40	53	2013	27	53	2014	57	62	2015	43	99	2016	37	74	2017	58	61	2018	49	60	2019	38	57	2020	75	100	2021	35	45	2022	25	21	2023	15	21	2024	1	1	<p>75% Sciences 3% Business & Others 17% Engineering 5% Arts & Humanities</p>	<p>Our students hail from 32 COUNTRIES</p> <p>43 STUDENTS had their PhDs before admission</p> <p>45% of MD students were working before they started their medical training at Duke-NUS (since 2005)</p> <p>111 STUDENTS completed their master's degrees before admission</p>
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<ul style="list-style-type: none"> Internal Medicine Family Medicine Paediatric Medicine Diagnostic Radiology Anaesthesiology Emergency Medicine Psychiatry 	<p>60 Transition Awards*</p> <p>62 Clinician Scientist Awards*</p> <p>14 Singapore Translational Research (STaR) Investigator Awards* (cumulative)</p> <p>* Duke-NUS faculty and faculty holding primary academic appointments at Duke-NUS</p>	<p>>11000 papers published in international peer-reviewed journals (as of 31 July 2022)</p> <p>>3000 faculty in research and education</p> <p>>\$772m in research funding locally and overseas</p> <p>11 current Singapore Translational Research (STaR) Investigators</p> <p>>300 Synergistic Research Alliances</p> <p>3 National Research Foundation Investigatorships</p> <p>8 National Research Foundation Fellowships</p>																																													
CREATING NEW SOLUTIONS (as of March 2023)		FROM BENCH TO BEDSIDE (as of March 2023)																																													
<p>>40 licences completed</p> <p>>130 patents filed</p>		<p>22 start-up companies by Duke-NUS investigators</p> <p>>250 invention disclosures submitted for review</p>																																													



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Communications &
Strategic Relations Department

DukeNUS
Medical School

8 College Road, Singapore 169857

 enquiries@duke-nus.edu.sg

 +65 65167666

 www.duke-nus.edu.sg

 sg.linkedin.com/school/duke-nus

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