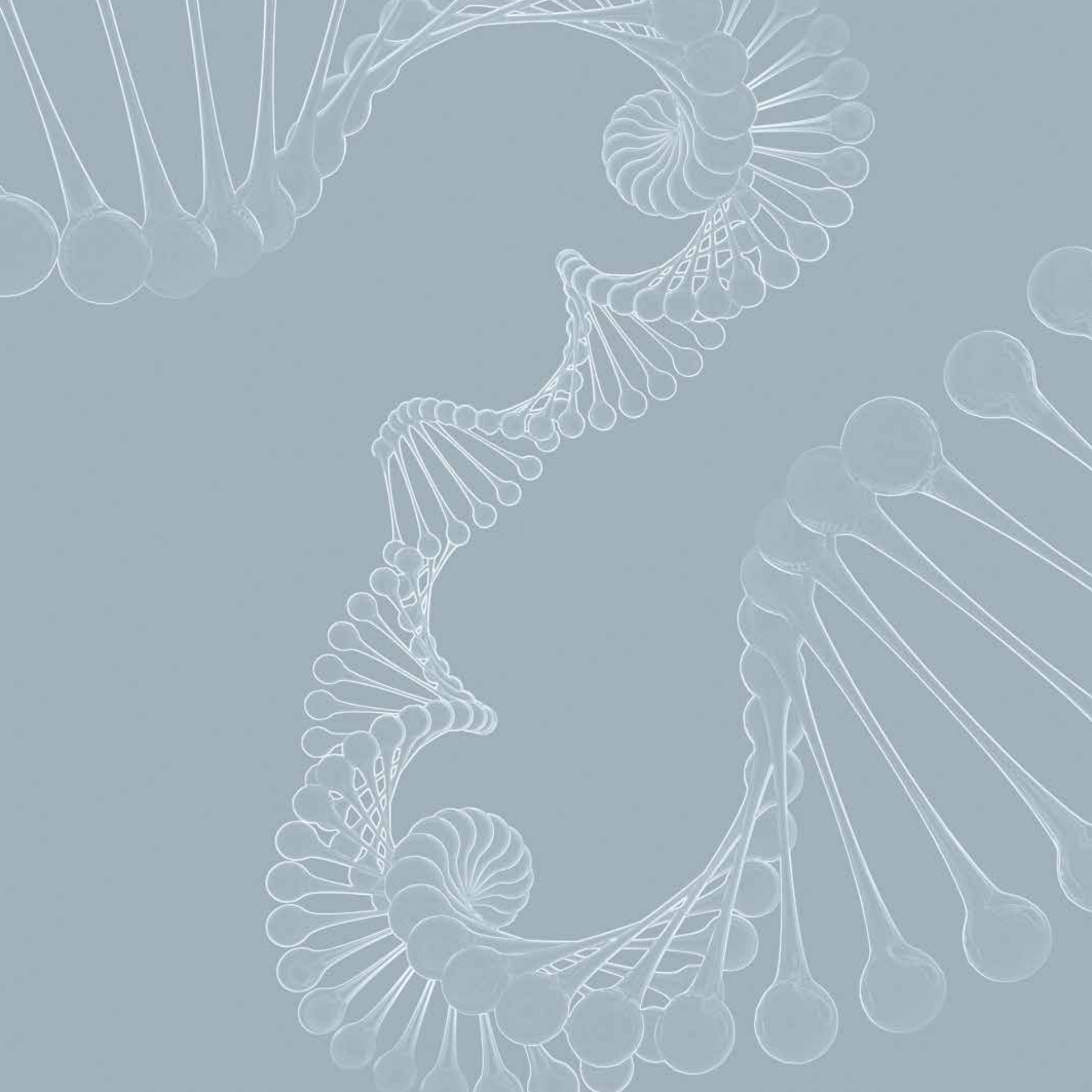
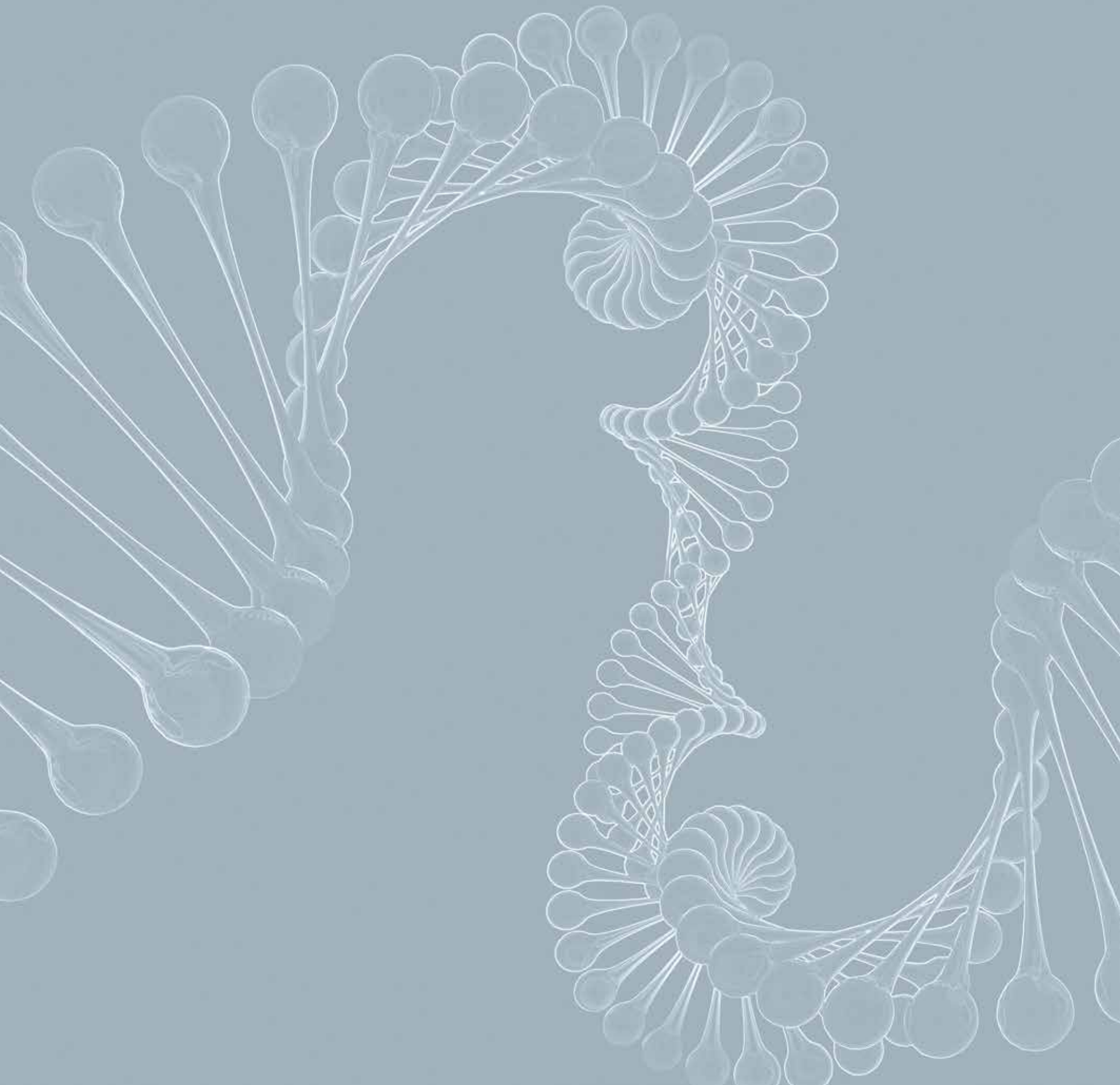
DukeNUS
Medical School

# 15
*Years*
*of Impact*






DukeNUS Medical School

*Transforming Medicine, Improving Lives*

**Duke-NUS Medical School: 15 Years of Impact**

Published by Duke-NUS Medical School



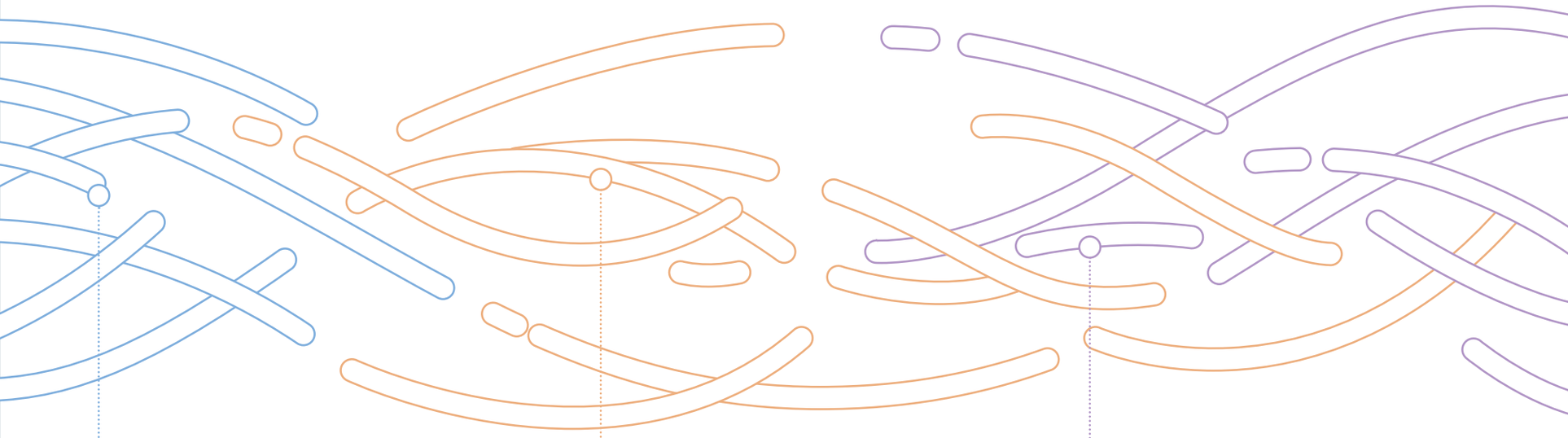
**ISBN: 978-981-14-7721-8**

**National Library Board, Singapore Cataloguing in Publication Data**

Name(s): Sharma, Anirudh, editor. | Koh, Jane, editor. | Koh, Karen, editor. | Lim, Nicole, editor. | Duke-NUS Medical School, publisher.
Title: Duke-NUS Medical School : 15 years of impact / editors, Anirudh Sharma, Jane Koh, Karen Koh and Nicole Lim.
Description: Singapore : Duke-NUS Medical School, 2020. | Curated in collaboration with Oxygen Studio Designs Pte Ltd.
Identifier(s): OCN 1198009012 | ISBN 978-981-14-7721-8 (hardback)
Subject(s): LCSH: Duke-NUS Medical School. | Medical colleges--Singapore--History. | Medical education--Singapore--History.
Classification: DDC 610.7115957--dc23

# *contents*





## IN THE BEGINNING



## EXPANDING, CONNECTING



## A LASTING IMPACT

# *Foreword*

Duke-NUS Medical School was conceived 15 years ago as part of a vision to transform Singapore into the biomedical hub of Asia. As a collaboration between Duke University in the United States and the National University of Singapore, the School aims to provide both innovative education and impactful research.

Duke-NUS' strength in translational research has lent itself to contribute to the diagnosis and treatment of novel infectious diseases. Recently, scientists from the School's Emerging Infectious Diseases Signature Research Programme isolated and cultured the SARS-CoV-2 coronavirus in just four days. They also developed a test kit which can rapidly detect neutralising antibodies without the need for specialised equipment or bio-containment facilities. Together with San Diego-based biotechnology company Arcturus Therapeutics, the School has also developed an mRNA vaccine — LUNAR-COV19, which is currently undergoing Phase I & II clinical trials in Singapore.

Other notable partnerships have borne positive results. In the area of cancer, the first publicly funded drug candidate, ETC-159, developed with the Agency for Science, Technology and Research, received approval from the US Food and Drug Administration and the Health Sciences Authority last year to start enrolment into Phase 1B clinical trials. Besides biomedical research, Duke-NUS has also made strides in social research through its Centre for Ageing Research and Education. A nationally representative survey — the Transitions in Health, Employment, Social Engagement and Intergenerational Transfers in Singapore Study — by the Centre has laid a good foundation for the design of policies and programmes that cater to the changing needs of seniors.

Duke-NUS has also grown significantly on the education front. The School recently reformed its 'Clinicians First, Clinicians Plus' curriculum, which was built on the progressive learning pedagogical approach, TeamLEAD (Learn, Engage, Apply and Develop). It has extensively revised clinical training, leveraged technology-enhanced learning and introduced a more robust programme of assessments as well as simulation training focusing on procedural skills, patient safety and team work. The research-intensive focus of Duke-NUS' MD and MD-PhD programmes continue to be an important platform in nurturing future generations of clinician scientists and researchers who are trained to bridge basic and clinical science, and drive the translation of research into practice.

I congratulate Duke-NUS on its achievements over the last 15 years and look forward to more ground-breaking research and education work that will continue to advance healthcare, and improve and save lives in the years ahead.

**Mr Gan Kim Yong**
*Minister for Health, Singapore*

# *Foreword*

When the Duke-NUS Medical School was established in 2005, it marked a milestone in Singapore's transition into an internationally recognised biomedical sciences hub. How Duke-NUS helped Singapore realise this vision was through the training of clinicians and clinician scientists, who are able to both practise medicine and apply scientific discovery to real-world applications.

Since then, Duke-NUS has been producing a pipeline of outstanding talents, promising to be leaders in their fields, with the capabilities to improve patients' lives and healthcare outcomes. One such alumni is clinician scientist Dr Ku Chee Wai. His work in the field of early pregnancy led to him being conferred the National Outstanding Clinician Scientist Resident award, the SingHealth David Sabiston Gold Medal in Surgery, and the SingHealth Prize in Obstetrics and Gynaecology.

Duke-NUS is now an integral part of a dynamic biomedical ecosystem — comprising the academic rigour of our undergraduate medical schools, a vibrant biomedical industry and renowned research institutes.

The value of such a system is displayed in our fight against COVID-19. Professor Wang Linfa, Director of Duke-NUS' Emerging Infectious Diseases Programme, and his team of scientists was the first to develop antibody tests to detect COVID-19 and was also one of the first groups in the world to isolate and culture the virus.

In translational research, the School's landmark studies have seeded new treatment options for fatty liver disease and complications in early pregnancy. The School's uncovering of the dengue virus structure has also aided in furthering vaccine development and treatments. In a first-of-its-kind study, the School also uncovered the mechanism that underlies epileptic seizures in Angelman Syndrome.

In education, its graduate-entry pathway brings together students from various institutions and disciplines to enrich the field of medicine through their wealth of expertise and experience. The students display a strong sense of community service, and they undertake a range of projects. For example, in "Project I'm Steady Lah", Duke-NUS students provide free psychiatric assessments and organise forum sessions to tackle the stigma surrounding mental health issues among young adults. They have also collaborated with partners like Mount Alvernia hospital and NTUC SilverACE Senior Activity Centre on a health awareness and monitoring programme for the elderly.

Congratulations to Duke-NUS on your remarkable journey thus far. You are nurturing the next generation of leaders in the medical field, who will, in turn, shape the future of Singapore's medical landscape with their dynamism and fortitude.

**Mr Ong Ye Kung**

*Minister for Education, Singapore (2015–2020)*

# *Chairman's Message*

Duke-NUS Medical School was established in April 2005 as a partnership between two world-renowned institutions, Duke University and the National University of Singapore (NUS), with a vision of *educating pioneering clinicians* for Singapore and beyond. As a research-intensive, graduate-entry medical school, Duke-NUS aimed to bring mature students with advanced academic credentials and diverse life experiences into Singapore's medical community. The School would focus on carrying out translational research with impact, and nurturing students with the potential to become clinician scientists.

Duke-NUS has, over the last 15 years, been internationally lauded for excellence in education, multi-disciplinary research and innovation, pushing boundaries as it advanced with Singapore Health Services (SingHealth) towards a world-class Academic Health System aimed at continually *transforming medicine and improving lives.* I am delighted that Duke-NUS' Academic Medicine partnership with SingHealth has resulted in outstanding clinical research, evident from Newsweek Magazine's ranking of Singapore General Hospital as the world's third best hospital in March 2019.

*Our core belief is that combining research and education in a clinical setting improves patient care and transforms medical practice.*

Our past ten cohorts of MD (Doctor of Medicine) graduates and six cohorts of PhD (Doctor of Philosophy) graduates have distinguished themselves through excellent clinical work, numerous publications and presentations, national awards for clinical research and an affinity for innovation and entrepreneurship. Some of our alumni have emerged as leaders — National Outstanding Clinician Scientist Resident Award winners, chief residents, founders of online healthcare platforms and businesses, as well as leading educators.

Duke-NUS collaborates intensively with its parent institutions, Duke and NUS, but has also deepened pathways with Singapore Management University, Singapore University of Technology and Design and Nanyang Technological University, Singapore, in keeping with Singapore's National Health Outcomes Framework, enhancing its catalyst role of producing clinicians with a pioneering spirit. These are keen on blazing new trails in science and leadership careers: *'Clinicians Plus'*.

Our core belief is that combining research and education in a clinical setting improves patient care and transforms medical practice. A strong academic environment in a medical centre is necessary for the career development of trainees interested in careers as clinician scientists, educators, innovators and leaders.

Our signature research programmes have generated *impactful discoveries* that have changed clinical practice, while garnering international awards and competitive funding. Beyond that, our discoveries have spawned multiple start-ups and commercial ventures that facilitated their adoption in the public domain. To date, Duke-NUS has achieved an impressive number of invention disclosures, patent applications, registered trademarks and licensing.

Our success is founded on the unwavering support of our generous stakeholders, as well as the concerted efforts of our present and past leadership, faculty, staff and students. I am excited to work with these talented individuals on their journey of excellence. I trust you will find the milestones documented in this book inspiring.

**Mr Goh Yew Lin**

*Chairman of the Governing Board,*
*Duke-NUS Medical School*

# *Dean's Message*

As we mark 15 years since Duke-NUS Medical School was established as Singapore's only graduate-entry medical school, we celebrate our accomplishments in outstanding education, cutting-edge research and impactful innovation.

Born out of a partnership between two world-class institutions — Duke University and NUS — Duke-NUS has met the Singapore government's goal of producing a pipeline of future-ready clinicians and clinician scientists, as well as propelling the country's biomedical research industry. All these would not have been possible without the generosity and faith of our esteemed benefactors and donors, especially the Estate of Khoo Teck Puat. Their continued support has allowed us to develop into a vibrant institution where greater things happen.

You will discover, in this tome, that Duke-NUS has exceeded its goals, both as a world-class medical school and a leader in translational research. As of 2020, our MD programme has graduated 502 students, many of whom have won national awards for research, formed their own start-up companies and produced hundreds of scientific publications. At the core of our educational philosophy is our 'Clinician First, Clinician Plus' programme. This nurtures highly competent clinicians with the additional skills to become scientists, educators, innovators and leaders who will help steer our evolving healthcare system.

As a research-intensive medical school, we have demonstrated new ways of understanding diseases, changing treatments and diagnostic strategies. Our investigators have been granted a total of 73 patents and 22 licences, while forming 16 start-up companies.

Our overall success has been supported by our strategic Academic Medicine partnership with SingHealth, and the formation of the SingHealth Duke-NUS Academic Medical Centre (AMC). This AMC consists of a rich, multi-disciplinary ecosystem that has allowed us to translate education and research into improved healthcare outcomes. With the Singapore General Hospital being named the world's third best hospital by Newsweek Magazine, we are thrilled that our students are receiving their clinical training in a world-class clinical environment.

I hope that you will enjoy reading about our collective achievements, garnered under the dedicated leadership of an outstanding Governing Board led by our exceptional Chairmen Mr Tony Chew (2005–2011), Mr Kai Nargolwala (2011–2019) and Mr Goh Yew Lin (2019–present).

*As a research-intensive medical school, we have demonstrated new ways of understanding diseases, changing treatments and diagnostic strategies.*

Moving forward, we will continue to position the School as a unique pathway to a career as an outstanding clinician with broader interests in research, education, health policy, innovation and administration. We will also work to strengthen our partnership with SingHealth, and collaborate with key institutions in Singapore and beyond. We remain dedicated to our mission of transforming medicine and improving lives.

**Professor Thomas M Coffman**
*Dean, Duke-NUS Medical School*

# *Message from National University of Singapore*

In 2005, two world-renowned institutions — NUS and Duke University — came together to form Singapore's first and only graduate-entry medical school: Duke-NUS Medical School. This year, we proudly celebrate the 15th anniversary of this successful union, which has produced a total of 502 graduates since Duke-NUS' first intake in 2007.

Within a short span of time, Duke-NUS has made an indelible impact on the biomedical sciences in Singapore and abroad by transforming medicine, innovating learning and helping society. The many breakthroughs made in clinical and translational research are rooted in a progressive, multi-disciplinary approach that enables research discoveries to be applied to real-world problems. Findings are translated into solutions that have the potential to impact millions of lives — the novel home-grown anticancer drug ETC-206, and the first-in-class therapies to block interleukin-11, the key driver of fibrosis in heart and kidney failure, are just two of the many instances of Duke-NUS' life-changing work.

During the COVID-19 pandemic, a team from the Duke-NUS Emerging Infectious Diseases Programme was among the first research teams in the world to culture the SARS-CoV-2 coronavirus. The same team was instrumental in assisting with Singapore's contact tracing efforts by identifying the missing link between three major COVID-19 clusters. The team has also developed a unique test kit capable of rapidly detecting neutralising antibodies without the need for specialised equipment or containment facilities.

On the academic front, Duke-NUS has pioneered an innovative approach to learning — TeamLEAD — that has, true to its name, led and shaped pedagogical thinking locally and internationally. This process, where students Learn, Engage, Apply and Develop through practical problem-solving and small group discussions, has since been used by Duke University and various schools in Singapore. TeamLEAD has nurtured cohort upon cohort — including the 10th batch of MD graduands, whom we celebrate this year — to be curious, critical, nimble thinkers who look beyond traditional elements of healthcare practice, and into the evolving challenges of tomorrow's medicine.

*To celebrate Duke-NUS' achievements is also to celebrate the partnerships that have been integral to its success.*

To celebrate Duke-NUS' achievements is also to celebrate the partnerships that have been integral to its success. Since 2005, the partnership between Duke-NUS and SingHealth, Singapore's largest healthcare cluster, has laid the groundwork for innovative approaches to clinical care, education and research. This collaboration, which entered its third phase in 2017, allows Duke-NUS students to apply their learning, research and practice in real clinical settings, and experience inter-professional learning.

I congratulate Duke-NUS on its remarkable achievements over the past 15 years. These achievements have been enabled, in no small part, by the values at the core of Duke-NUS — compassion, courage, integrity and collaboration — which resonate with NUS' own beginnings as a modest medical school founded in 1905 by the community, in service of the community. As we behold a rapidly changing landscape that increasingly calls for new healthcare innovations and systems, I am certain that these qualities will steer Duke-NUS towards an even brighter future.

**Professor Ho Teck Hua**

*Senior Deputy President and Provost*
*Tan Chin Tuan Centennial Professor*
*National University of Singapore*

*Deputy Chairman of the Governing Board,*
*Duke-NUS Medical School*

# *Message from Duke University*

Duke-NUS Medical School's journey has been nothing short of inspiring. Back in 2005, Duke University and National University of Singapore (NUS) — two top-ranked institutions — partnered to establish Duke-NUS.

For Duke, this was a strategic opportunity to have a global presence and apply the best of science to the challenges of global health. Choosing to plant our roots in Singapore was fitting, given the country's reputation as having one of the best education systems in the world, as well as a first-class government with a vision of building the country into Asia's leader in biomedical science.

With mentorship from Duke's research faculty, as well as Duke and Duke-NUS research collaborations, the School is steadily nurturing a new pipeline of clinician scientists for Singapore. Moreover, it is catalysing seminal scientific discoveries and pioneering impactful clinical innovations that will improve health in Singapore and beyond for years to come. Within the span of less than two decades, the School has grown to become firmly positioned as a leader in translational research and medical education. The remarkable achievement is evinced in its curriculum that fosters critical thinking to solve healthcare issues, as well as its discoveries that have culminated in impactful therapies and start-ups.

We're also extremely proud of the cohorts of high-calibre students that have been matriculated at Duke-NUS. In fact, I have had the pleasure of personally celebrating their transition into clinicians in the last five graduation and hooding ceremonies that have taken place at Duke-NUS. Notably, in 2019, the Duke-NUS PhD in Integrated Biology and Medicine (IBM) cohort was the first batch to be awarded a joint degree endorsed by both Duke and NUS, spelling greater international recognition for the graduands.

Bolstered by its partnership with SingHealth, Duke-NUS has managed to bring its translational research from bench to bedside. The world-class SingHealth Duke-NUS Academic Medical Centre, distinguished by its Academic Clinical Programmes, has catalysed improvements in patient care.

I have every confidence that the continued synergy between Duke and NUS will boost Singapore's initiative to become the premier centre of excellence for academic medicine in the region and beyond.

*I would like to take the opportunity to congratulate our talented and dedicated faculty, staff and students on their many distinguished achievements and contributions.*

I am delighted to chart Duke-NUS' monumental rise, as well as witness first-hand, its robust spirit of collaboration. As we celebrate the various milestones that underscore the School's success, I would like to take the opportunity to congratulate our talented and dedicated faculty, staff and students on their many distinguished achievements and contributions.

**Professor A Eugene Washington, MD**
*Chancellor for Health Affairs, Duke University*
*President and CEO, Duke University Health System*
*Member of the Governing Board,*
*Duke-NUS Medical School*

# *Message from SingHealth*


*I am excited for what the future holds as we continue to gain momentum in pushing the boundaries of our Academic Medicine pursuits to stand shoulder to shoulder with the top AMCs in the world.*

This year marks the 15th anniversary of Duke-NUS Medical School, and 15 years of Academic Medicine partnership between SingHealth and Duke-NUS. What a journey it has been! The SingHealth Duke-NUS Academic Medical Centre (AMC) has grown from strength to strength as we push the frontiers of research and nurture the healthcare professionals of tomorrow.

To date, we have 98 clinician scientists and 936 SingHealth clinician educators who have taught or are currently teaching at Duke-NUS. Our researchers have contributed more than 22,000 publications in international peer-reviewed journals. Also testament to this sterling partnership is that we have received more than $1.91 billion in competitive research funding, as well as philanthropic gifts, which are reflective of the trust our donors and partners have in our AMC.

We stand united in our goal to improve the health of patients and the community because we understand that all three components of clinical care, research and teaching are closely related and equally important. By creating platforms that foster sharing, ignite new conversations and change the way we work, we have nurtured a conducive environment for the exchange of scientific and clinical perspectives. The set-up of Academic Clinical Programmes, Joint Institutes and Disease Centres has sparked important research initiatives, some of which have put us in the global spotlight, and new care models.

Most importantly, these achievements have and continue to make a difference for our patients. Our AMC delivers the bulk of public healthcare in Singapore. Therefore, our work directly addresses the clinical challenges that we encounter and impacts the most number of patients and their families. Our patients are receiving more holistic and integrated care at our 11 SingHealth Duke-NUS Disease Centres, more right-sited care as we deepen our expertise in health services research and effective treatments as we translate scientific findings and bring them to the patient's bedside.

Still, there is much more to be done. Disease knows no boundaries, as we know from global health emergencies such as COVID-19. I am excited for what the future holds as we continue to gain momentum in pushing the boundaries of our Academic Medicine pursuits to stand shoulder to shoulder with the top AMCs in the world. On behalf of SingHealth, I congratulate Duke-NUS on your outstanding achievements as we look forward to breaking new ground in defining tomorrow's medicine in the years ahead.

**Professor Ivy Ng**

*Group Chief Executive Officer, SingHealth*

*Member of the Governing Board, Duke-NUS Medical School*

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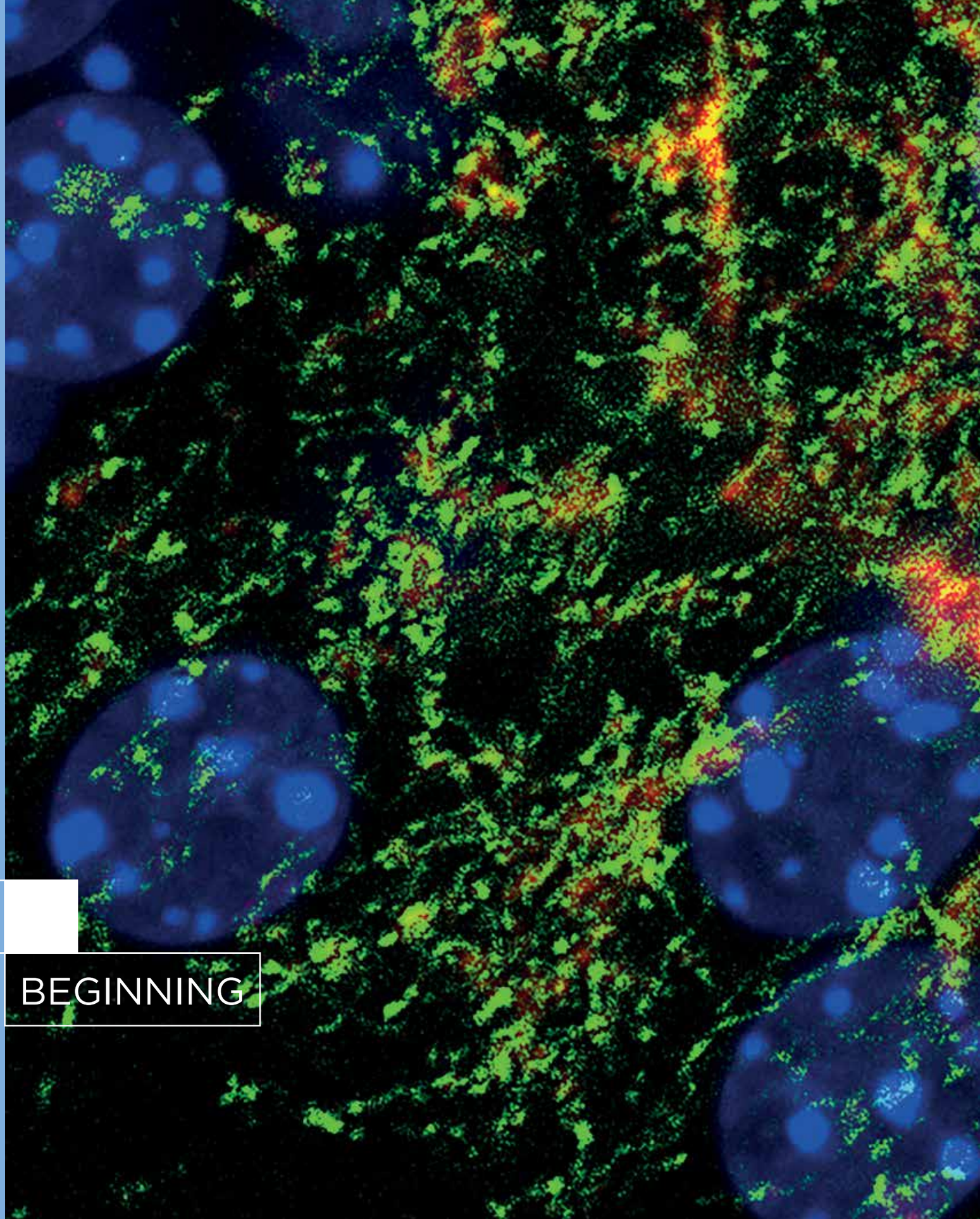
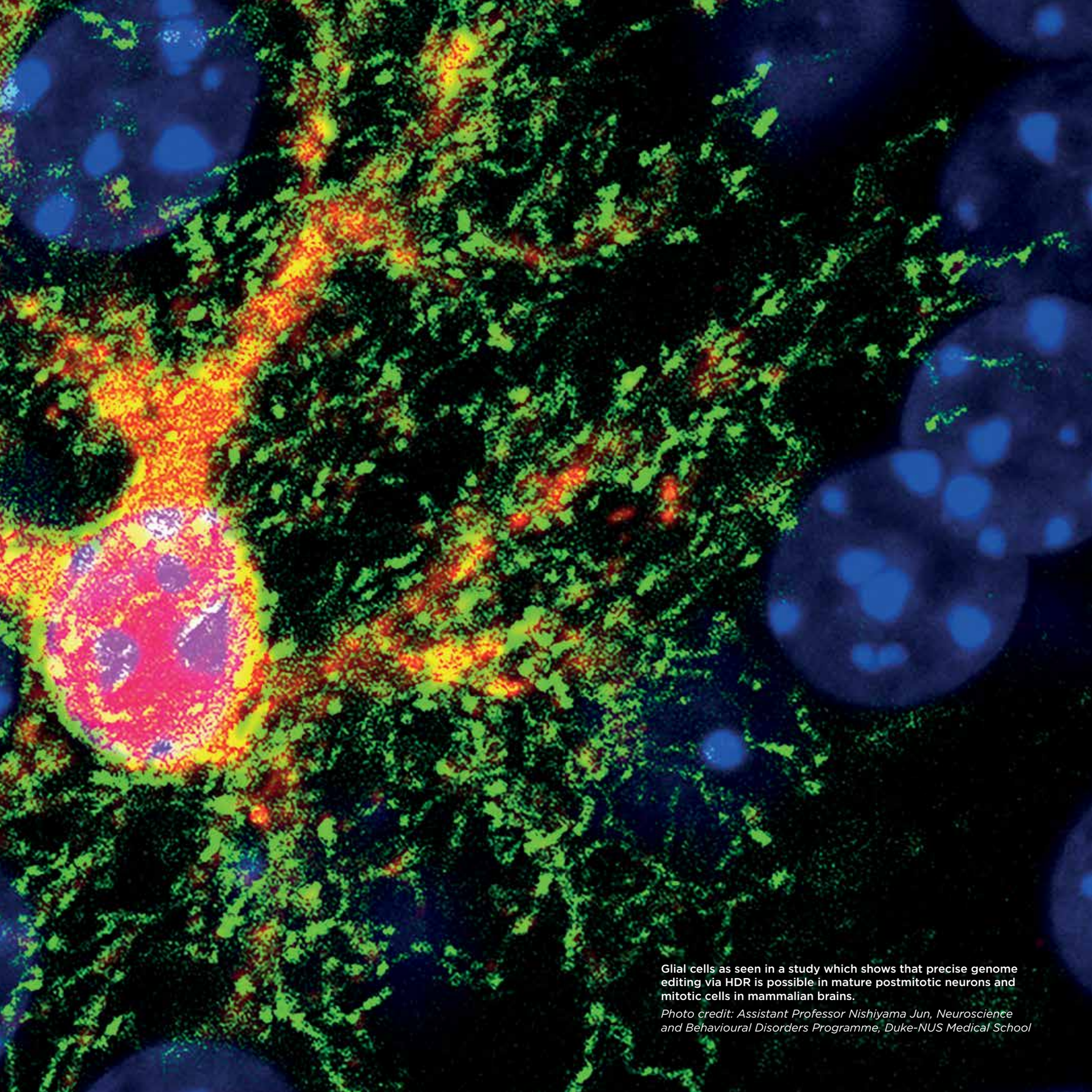
President and CEO,
Duke University Health System

The establishment of an institute is often marked with a plenitude of firsts. From the nascent stages of the School's formation to the building of its campus, and the assemblage of the first class to the inauguration of its first commercial start-up, Duke-NUS celebrates new beginnings and the people who made it all possible.

# IN THE BEGINNING





**Glial cells as seen in a study which shows that precise genome editing via HDR is possible in mature postmitotic neurons and mitotic cells in mammalian brains.**

*Photo credit: Assistant Professor Nishiyama Jun, Neuroscience and Behavioural Disorders Programme, Duke-NUS Medical School*

# *Genesis* — Birth Of A New Graduate Medical School

The idea of developing Singapore's first graduate-entry medical school began in 2000, with the introduction of the government's Biomedical Science Initiative. With a well-established healthcare system, Singapore was poised to become the biomedical hub of Asia, attracting research and health sector manufacturing capabilities to the country.

After a memorandum of understanding was signed in 2003, the Duke-NUS partnership was formalised in April 2005. Drawing upon the expertise of Duke University and NUS, Duke-NUS boasts a novel hybrid model of clinical medical training and research as part of its curriculum. The proposed location for the university in Outram would further foster significant translational and patient-oriented research in close collaboration with Singapore General Hospital and specialty centres in the area.

With the foundation laid out for a robust future in biomedical sciences, the subsequent course of action was to develop and nurture highly-trained clinician scientists to establish and support the fledgling sector. Designed around the Duke model of education, Duke-NUS offers a graduate-entry, four-year medical programme, which includes one year dedicated to independent study and undertaking research projects of a basic science or clinical nature. The curriculum has been specially formulated to develop an exceptional pool of leaders and creative thinkers to constantly push the boundaries of medicine and enhance medical research, medical education and patient care.

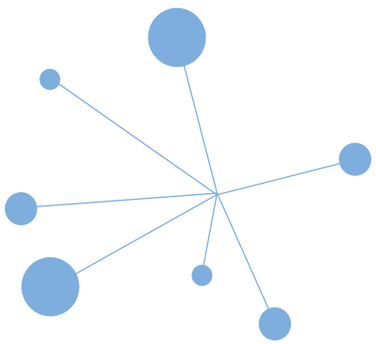
Since its inception, Duke-NUS has welcomed students from diverse academic backgrounds and different professions, with diverse disciplines and years of career experience under their belts. Against the backdrop of a rich, multi-disciplinary Academic Medicine ecosystem, coupled with world class medical training, the School nurtures a pipeline of outstanding clinicians and clinician scientists who will pioneer innovations, translate research into better health outcomes and advance the healthcare system in Singapore and beyond.

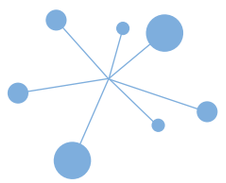
### Duke University School of Medicine

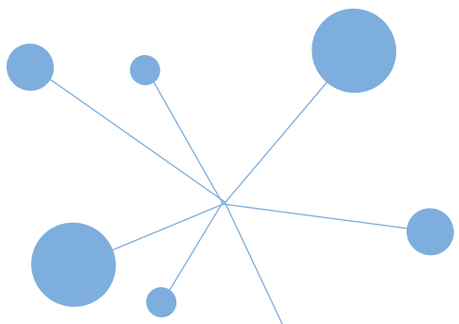
Established in 1930, Duke University School of Medicine is the youngest of America's top medical schools. Ranked among the best in the nation, the School takes pride in being an inclusive community of outstanding learners, investigators, clinicians and staff dedicated to educating the next generation of biomedical scientists and healthcare providers, and accelerating the translation of scientific discoveries to improve human health locally and around the globe.

### National University of Singapore

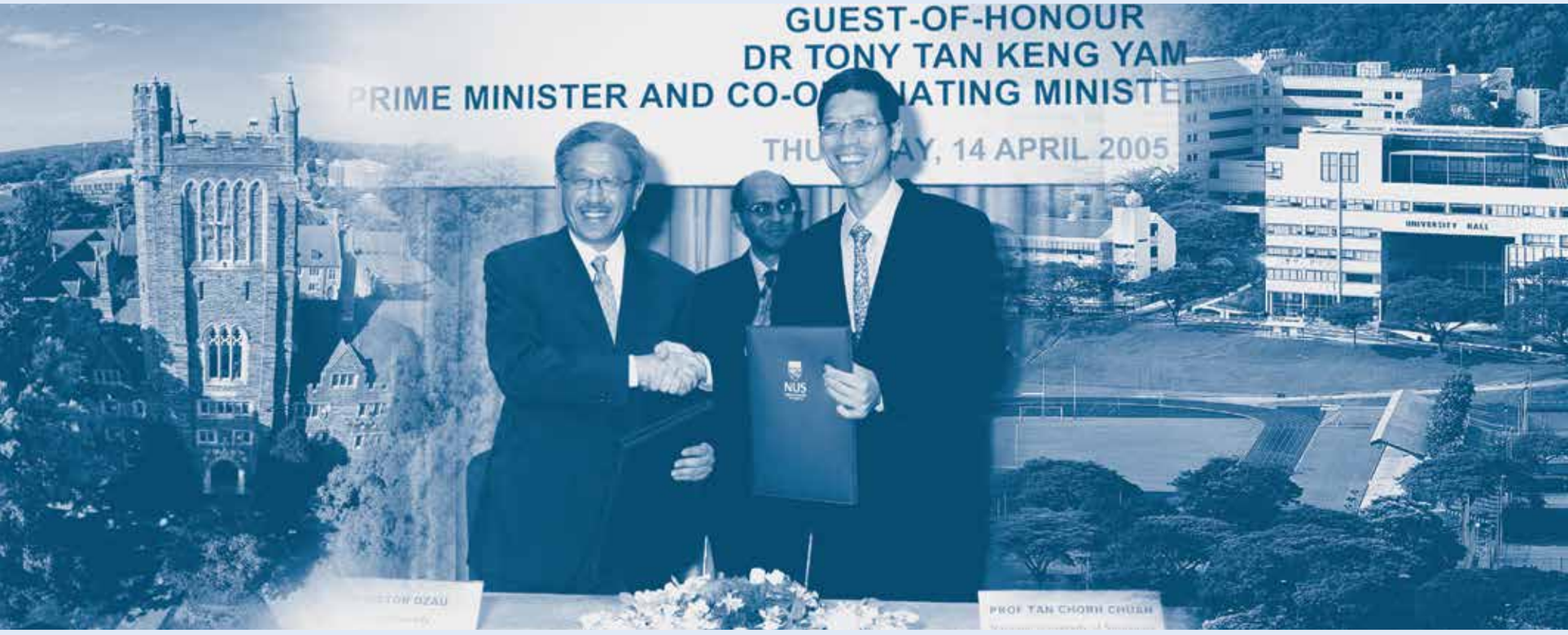
The National University of Singapore is Singapore's flagship university, and one of the leading universities in Asia. It has pioneered innovative models of education, and a multi-disciplinary approach to research and entrepreneurship that has contributed towards improving lives and the needs of society. In 2020, as the University celebrates 115 years since its founding, it continues to shape the future for a better world.








▲ The official signing of the memorandum of understanding.




▲ Professor Victor J Dzau, Chancellor Emeritus and James B Duke Professor of Medicine, Duke University, and Professor Tan Chor Chuan, former President, National University of Singapore, at the signing ceremony in 2005.

# *Founding Chairman*

**Mr Tony Chew Leong Chee**

- Executive Chairman, Asia Resource Corporation
- Board Member, SingHealth
- Founding Chairman, Duke-NUS Medical School (2005–2012)

*"I hope that in the years ahead, Duke-NUS will continue on its path to become a leading medical school in Asia, with excellent faculty and students from Singapore and all over the world. And that Singapore will become a premier regional hub for medicine, healthcare and biomedical research. This was Singapore's vision. This is my hope for the Duke-NUS, and for Singapore."*

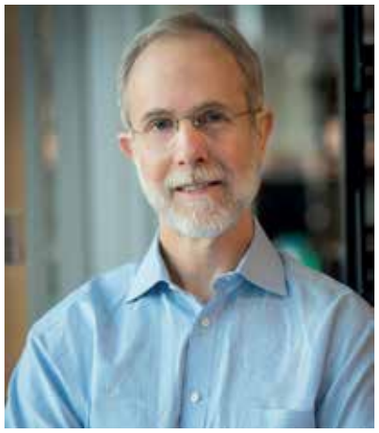
" I was invited by Minister Tharman, then Minister for Education, for breakfast in July 2005. He shared the plan to set up a new graduate-entry medical school in Singapore. Adopting the US MD system, it was to produce a new breed of medical doctors, the "clinician scientist". This was a new direction for Singapore. In the same meeting, he asked me to be the Chairman.

I was very moved after reading the briefing paper *"The Vision and Objectives of the NUS Graduate Medical School".* It presented a new vision for Singapore, to become a leading medical centre for Asia. Our little country, just 40 years old, had a dream to become a leader in medical education, healthcare, science and biomedical industry. As a Singaporean, I was inspired.

The vision showed great boldness. It takes courage to set a high bar, so high, that it seems impossible and unreachable. But this is how Singapore can survive. We must always set high targets and undertake big challenges. This vision was to guide me, for many years and even today.

Looking back on my 30 years of public service, I can say that the founding of Duke-NUS stands out — this has been most satisfying. But the journey is ongoing. Since 2014, I have served on the SingHealth Board and continue to support the SingHealth Duke-NUS Academic Medical Centre."

# *Founding Dean*



**Professor R Sanders Williams, MD**

- Professor of Medicine and Dean Emeritus, Senior Advisor for Science & Technology, Duke University School of Medicine
- Founding Dean, Duke-NUS Medical School (2005–2008)

*"I trust we laid a solid foundation for Duke-NUS, and that it will realise the ambitious dreams of its founders, and more."*

"I was first recommended by the Chancellor for Health Affairs and the President of Duke University, and then confirmed as Founding Dean by the Governing Board of Duke-NUS Medical School in Singapore.

In becoming the Founding Dean of Duke-NUS, I was filled with optimism and a sense of high adventure. I knew we were embarking on a difficult journey that would present many challenges and difficulties. However, I also understood that our goal was singularly important to both Singapore and Duke, that our plan was well-conceived, and that I was joined in effort by an exceptional group of people whom I trusted and admired.

The success of any endeavour depends primarily on the quality and commitment of the people driving the mission, and I was so very fortunate to engage with remarkable individuals from the onset, such as Mr Tony Chew, Prof Soo Khee Chee, Prof Tan Chorh Chuan, Mr Lim Chuan Poh, Prof Ivy Ng, Prof Tan Ser Kiat, Prof Pat Casey, Prof Bob Kamei, Prof Ed Buckley, Dr Tony Tan, our first classes of students, and many others who contributed so much during the early years of Duke-NUS and beyond.

My years with Duke-NUS provided some of the most interesting and memorable experiences of my career. It was thrilling to work in raw start-up mode, facing existential threats and overcoming them shoulder to shoulder with my courageous colleagues. It was satisfying to watch our team achieve our ambitious goals in creating an enterprise of lasting value. It was also deeply rewarding to gain understanding of life in Singapore, and to forge friendships that I think will last a lifetime. I trust we laid a solid foundation for Duke-NUS, and that it will realise the ambitious dreams of its founders, and more."

# *Early Trailblazers*
## — Illustrious Pioneers

### Professor Tan Chorh Chuan

- Chief Health Scientist, Ministry of Health (MOH), Singapore
- Executive Director, MOH Office for Healthcare Transformation
- Former Deputy Chairman of the Governing Board, Duke-NUS Medical School (2005–2008)

“ It's amazing how far Duke-NUS has come in a relatively short space of time! The early years were filled with long meetings, complex wall-to-wall Gantt charts and a great deal of hard work. But in that formative period, the spirit and culture of the institution was forged and continues to thrive to this day — the impulse to innovate, the commitment to make a deep impact in medicine, the desire to contribute to society and the eagerness to work with others in pursuit of excellence. Many outstanding individuals from Duke, NUS, SingHealth and the Singapore government played instrumental roles in the School's rapid progress. It was a great privilege to have been a part of this extraordinary journey, and I am also very grateful for the warm friendships and deep sense of collective purpose that made the joint work so meaningful and enjoyable.”

### Professor Victor J Dzau

- President, United States National Academy of Medicine
- Chancellor Emeritus and James B Duke Professor of Medicine, Duke University
- Member of the Health and Biomedical Sciences International Advisory Council
- Former Member of the Governing Board, Duke-NUS Medical School (2005–2014)

“ Just 15 years after its founding, Duke-NUS has established a global reputation as a leading medical enterprise that is transforming biomedical research and education in Singapore and around the world. Thanks to the leadership and dedication of many at Duke University and the NUS and the unwavering support of Singapore government leaders — as well as the enterprising spirit of Duke-NUS' students and staff — the university is on a trajectory for remarkable impact across science and human health. It is a tremendous honour and privilege to have been involved with this important partnership from the very beginning.”

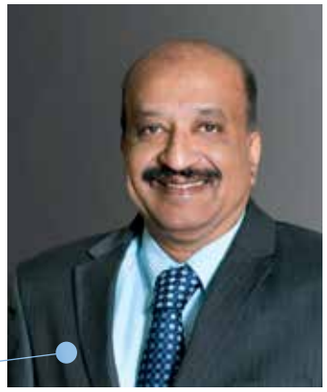
## Professor Tan Ser Kiat

- Chairman, SingHealth Fund
- Emeritus Consultant, Department of Orthopaedic Surgery, Singapore General Hospital
- Former Member of the Governing Board, Duke-NUS Medical School (2005–2016)

“Our vision for Duke-NUS was to train doctors who are not only clinically excellent in patient care but are also good clinician scientists who practice evidence-based medicine to ensure safe and effective outcomes for patients. Through my interaction with successive batches of Duke-NUS graduates, I’m very gratified that we have been successful in achieving this vision. We have nurtured a pipeline of strong clinician scientists whom I believe will make good healthcare leaders of tomorrow.”

## Professor Patrick J Casey

- Senior Vice Dean, Office of Research, Duke-NUS Medical School
- James B Duke Professor of Pharmacology & Cancer Biology



## Professor K Ranga Rama Krishnan, MB, ChB

- Chief Executive Officer, Rush University System for Health
- Former Dean, Duke-NUS Medical School (2008–2015)

“It was great to witness the School become successful, thanks to the support of Duke University, the NUS, and the enormous dedication and ownership, time, energy and support that came from SingHealth. It was an exhilarating time, which saw us create the PhD and MD-PhD programmes, build our residency training programme, and expand our research capabilities, including the prescient creation of ABSL 3 that has turned out to be critical during COVID-19. I am proud and thankful to have been part of the growth of Duke-NUS Medical School.”

“I have had the privilege of witnessing the amazing growth of Duke-NUS from Day 1, with so much support rendered to us from our parent universities, partners and stakeholders. It has been immensely gratifying to see how the School has advanced medical education, research and academic medicine in Singapore, and the impact our activities have had on the global stage. I am heartened to see how Duke-NUS has served her purpose, exemplifying our mission and vision. At this 15th anniversary, let us recommit our values of courage, integrity, compassion and collaboration as the driving force to bring Duke-NUS to even greater heights, and celebrate our contributions to healthcare and innovation.”

# *Breaking New Grounds* — The Duke-NUS Campus

In 1905, Singapore's first medical school — the Straits Settlement and Federated Malay States Government Medical School, now known as NUS Yong Loo Lin School of Medicine — was established at Sepoy Lines. A century later, the first graduate medical school was founded, with plans to construct its campus within the vicinity.

With construction of the Khoo Teck Puat Building beginning only in 2006, Duke-NUS first settled into its interim campus at 2 Jalan Bukit Merah. In May 2009, Duke-NUS bade goodbye to its Jalan Bukit Merah home and moved into its current campus at the heart of the Singapore General Hospital campus at Outram. The building was then officially opened by Prime Minister of Singapore Lee Hsien Loong on 28 September 2009.

Designed to support the Duke-NUS collaborative spirit, the purpose-built green-certified building features laboratories, research facilities and support stations, faculty offices, "post-doc pods", learning and training facilities, as well as a genomics facility and high-performance computing cluster.


◀ Our interim campus at 2 Jalan Bukit Merah.

▼ Atrium of the new Duke-NUS building on the Outram campus.

▶ The new Duke-NUS building was officially opened by Prime Minister of Singapore Lee Hsien Loong on 28 September 2009.

# *Growing Talent*
## — First MD Class

Duke-NUS welcomed its inaugural class of 26 medical students on 1 August 2007. They embarked on a Doctor of Medicine (MD) programme that provided active learning opportunities and supported and mentored students in their areas of interest, through the world-renowned TeamLEAD educational strategy that promotes collaboration and teamwork.

The path was paved with exciting challenges for the first cohort of students who graced the halls of Duke-NUS. Students had to make a transition — from leaving their careers to taking on an entirely new discipline — as they entered Singapore's first graduate medical school. Through innovation, critical thinking and teamwork, the diversified, multi-ethnic student body has gone on to achieve greater heights as clinician scientists, clinician leaders, clinician educations and clinician innovators, setting the benchmark at Duke-NUS and inspiring future students.

*"Our teaching strategy uses peer teaching to encourage questioning and enhance the students' ability to articulate and explain. Many expressed concern that our method would not work. But feedback showed that our students really enjoyed and saw the value of this learning experience. That encouraged us to move forward."*

**Professor Sandy Cook**

- Senior Associate Dean & Deputy Head, Office of Education, Duke-NUS Medical School
- Deputy Director, Academic Medicine Education Institute (AM.EI)

# *Developing Passion*
## — First PhD Class

Duke-NUS launched its inaugural PhD programme in Integrated Biology and Medicine (IBM) in August 2010, with 13 students in the first cohort. With an emphasis on translational bioscience, the programme distinguishes itself from others in Singapore and abroad by preparing researchers to translate their results from bench to bedside, with advanced training in one of Duke-NUS' five Signature Research Programmes.

Wanting to make a difference in the field of healthcare and medical science, the first batch of PhD students was highly driven to innovate and seek answers in their respective sub-specialties. Alongside their peers, they conquered the numerous trials and setbacks they faced during the course of their individual research, with eight students graduating at the inaugural convocation in May 2015.

The pioneer batch of PhD graduates then took the initiative to form the Duke-NUS Alumni (DNPA), to foster alumni bonds; raise awareness of PhD-specific issues among prospective, current and graduating students, as well as alumni; and facilitate networking and communication with potential employers, collaborators and stakeholders.

The PhD programme in IBM is the first of three PhD programmes currently offered at Duke-NUS, namely the PhD programme in Quantitative Biology and Medicine and PhD programme in Clinical Sciences.

*"Our PhD programme embraces innovative training in translational science and advanced technology. Students in our first PhD cohort truly embraced and trusted the novel approaches and each student helped to shape the programme. These pioneer students showed passion, dedication and determination and paved the way for all subsequent students."*

**Associate Professor Silke Vogel**

- Senior Associate Dean, Graduate Studies, Duke-NUS Medical School
- Deputy Director, Centre of Regulatory Excellence (CoRE), Duke-NUS Medical School

# *Setting The Groundwork*
## — First Research Award

Research is an integral component of education at Duke-NUS, with some of our earliest research providing the foundation for further studies.

In 2008, Professor Wang Hongyan won the Singapore National Academy of Science's Young Scientist Award. The award, organised by the Singapore National Academy of Science and supported by A*STAR, recognises her research on the asymmetric division of neural stem cells. The award is given to young researchers under the age of 35 who are actively engaged in research and development in Singapore, and display tremendous potential in becoming world-class researchers in their fields. Then an Assistant Professor with the Neuroscience and Behavioural Disorders Programme at Duke-NUS, Prof Wang was the first Duke-NUS researcher to win the award. Her research was instrumental in establishing fruit fly neural stem cells as a new model to study brain tumour suppressors, and discovering several brain tumour-suppressor genes in fruit flies. Her findings have contributed valuable insights into the molecular mechanisms of neural stem cell asymmetric division and brain tumour formation. Her research, which received a National Research Foundation (NRF) Research Fellowship award and a US$2 million research grant in 2009, has been published in top-tier scientific journals, including *Nature, Developmental Cell* and *The Journal of Cell Biology*. These have paved the way for Prof Wang's continuing research, including her team's subsequent discovery of protein complexes that disrupt the process known as dedifferentiation, which promotes tumour development. Prof Wang's team also uses fruit fly neural stem cells as a new model to discover molecular mechanisms underlying neurodevelopmental disorders.

Currently the Deputy Programme Director of the Neuroscience and Behavioural Disorders Programme, Prof Wang continues to be recognised for her accomplishments. In 2020, Prof Wang became the first woman from Singapore to be elected as an Associate Member of the European Molecular Biology Organization (EMBO). The EMBO Associate Membership is a prestigious achievement reserved for a small number of leading scientists outside Europe, in recognition of their research excellence and outstanding accomplishments.

▲ Professor Wang Hongyan

# *Improving The Community*
## — First Commercial Success

As trailblazers in medical science, Duke-NUS students and staff innovate with the goal of bringing their ideas to reality and improving the community.

In 2015, Brian O'Dwyer, who was then an Entrepreneur-in-Residence in Duke-NUS' Centre for Technology and Development (CTeD), founded CognaLearn, a learning science company that combines digital technology with team-based education and cognitive science developed at Duke-NUS. The company facilitates efficient and productive learning that leads to improved learning outcomes.

Since its inception, CognaLearn has worked with more than 75 academic, corporate and government institutions across 15 countries to enhance education through teaching software, train-the-trainer workshops and turnkey solutions.

Brian, who is also a Duke University MBA graduate, and his team at CognaLearn developed InteDashboard; the company's proprietary software solution that facilitates digital team-based learning. Used in 20 institutions across Asia, Australia and the United States, it guides students through the learning process from pre-work until lesson and evaluation, by aligning curriculum goals with appropriate learning strategies, resulting in a more cohesive curriculum.

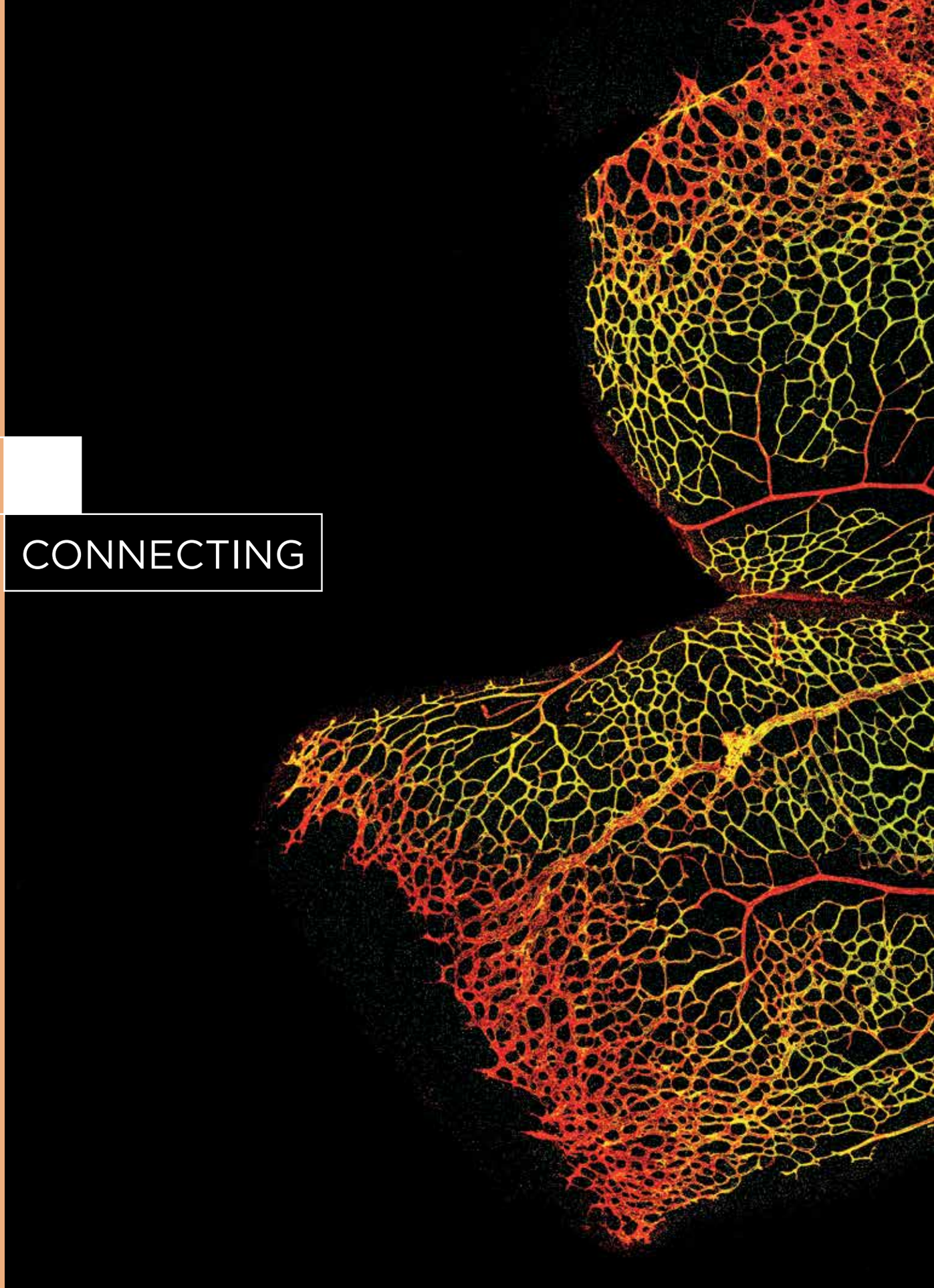
CognaLearn has achieved much since its founding, with recognition and accolades from both the Education and Information Technology sectors, winning awards at major platforms, such as the TechSauce Global Summit 2018, INSEAD Education Symposium 2018 and the Excellence in eLearning, World Education Congress and Awards. CognaLearn continues to advocate and propagate team-based learning to achieve its vision of improving outcomes for one million learners by 2025.

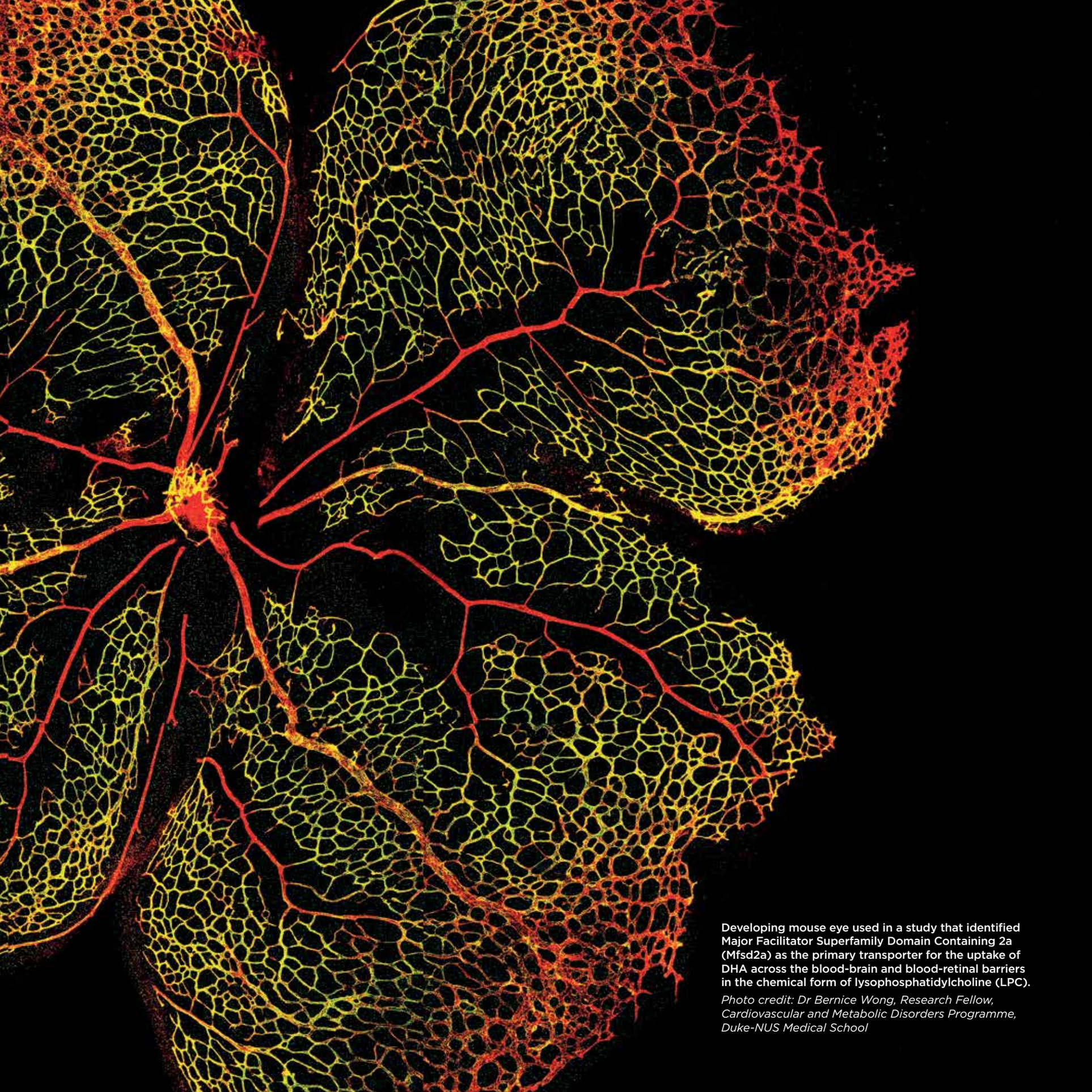
CognaLearn
LICENSEE OF DUKE-NUS OPTIMIZED LEARNING METHODS & TECHNOLOGY


▼ The CognaLearn team at the TechSauce Global Summit 2018.

# EXPANDING CONNECTING

As part of the rapidly evolving biomedical landscape, Duke-NUS continues to go from strength to strength, as a school and as a platform for clinical trailblazers to forge the path for the improvement and enhancement of healthcare in Singapore and the region. We look back on the diverse student body and groundbreaking research as we nurture and develop generations of Clinicians Plus.





**Developing mouse eye used in a study that identified Major Facilitator Superfamily Domain Containing 2a (Mfsd2a) as the primary transporter for the uptake of DHA across the blood-brain and blood-retinal barriers in the chemical form of lysophosphatidylcholine (LPC).**

*Photo credit: Dr Bernice Wong, Research Fellow, Cardiovascular and Metabolic Disorders Programme, Duke-NUS Medical School*

# *Branching Out* — Research With Impact

▶ Adult male *Eonycteris spelaea* bat enjoys a post health check beverage.

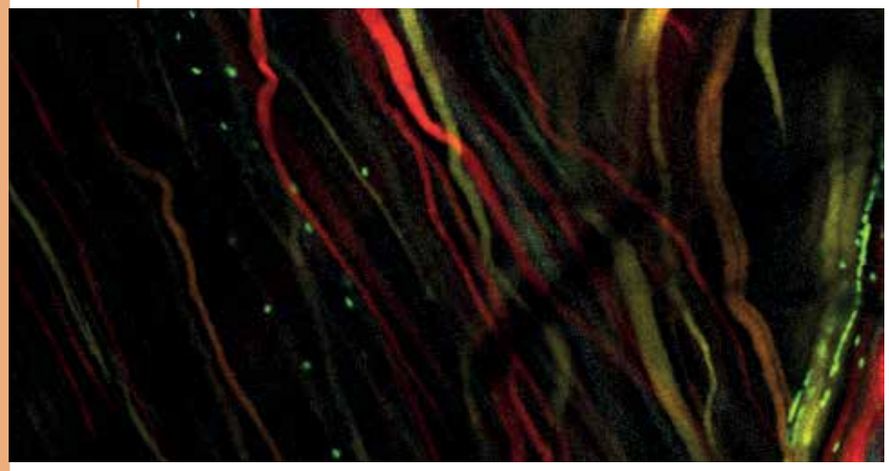
*Photo credit: Dr Zhu Feng, Research Fellow, EID Programme*

## Signature Research Programmes

Research is integral to Duke-NUS, particularly research relating to the major health burdens in Singapore and the region. Duke-NUS' five Signature Research Programmes were set up to address these concerns, with the aim of translating discoveries into clinical solutions.

▼ Mouse muscle can regenerate when muscle stem cells generate new progenitor cells. Stem cells were labelled with different colours of fluorescent proteins, and the resulting progenitor cells fused into multi-coloured muscle fibres with different parts of each fibre arising from different-coloured stem cells.

*Photo credit: Assistant Professor Lisa Tucker-Kellogg, CSCB Programme*



### Cancer and Stem Cell Biology

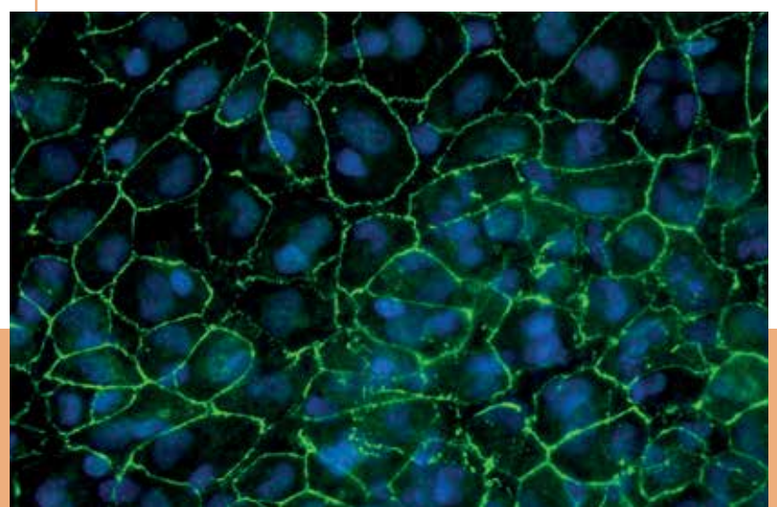
The Cancer and Stem Cell Biology (CSCB) Programme offers a broad scope of research, from hypothesis-driven basic science and disease-oriented investigation to active drug discovery and innovative clinical trials. The CSCB Programme works closely with researchers and clinicians all over Singapore, including the National Cancer Centre Singapore, the Department of Haematology at Singapore General Hospital on the Outram Campus of SingHealth, the Cancer Science Institute at the National University Hospital, and A*STAR.

### Cardiovascular and Metabolic Disorders

Cardiovascular and Metabolic Disorders (CVMD) such as hypertension and diabetes are a pressing concern in Singapore and Asia. The CVMD Programme spans the breadth of cardiovascular and metabolic research, with deep expertise in the areas of fat cell biology, the blood-brain barrier, mitochondrial health, diabetic kidney disease, heart development, human genetics and clinical trials. It aims to define the molecular mechanisms underlying human health and disease and to discover new approaches to prevent, diagnose and treat cardio-metabolic illnesses. The proximity of National Heart Centre Singapore and Singapore General Hospital's Diabetes and Metabolism Centre to one another presents myriad opportunities for collaboration in translational and clinical research.

▼ Cultured epicardial cells from mouse embryonic heart ZO-1 proteins (stained green) indicate that these cells are epithelial.

*Photo credit: Assistant Professor Manvendra K Singh, CVMD Programme*



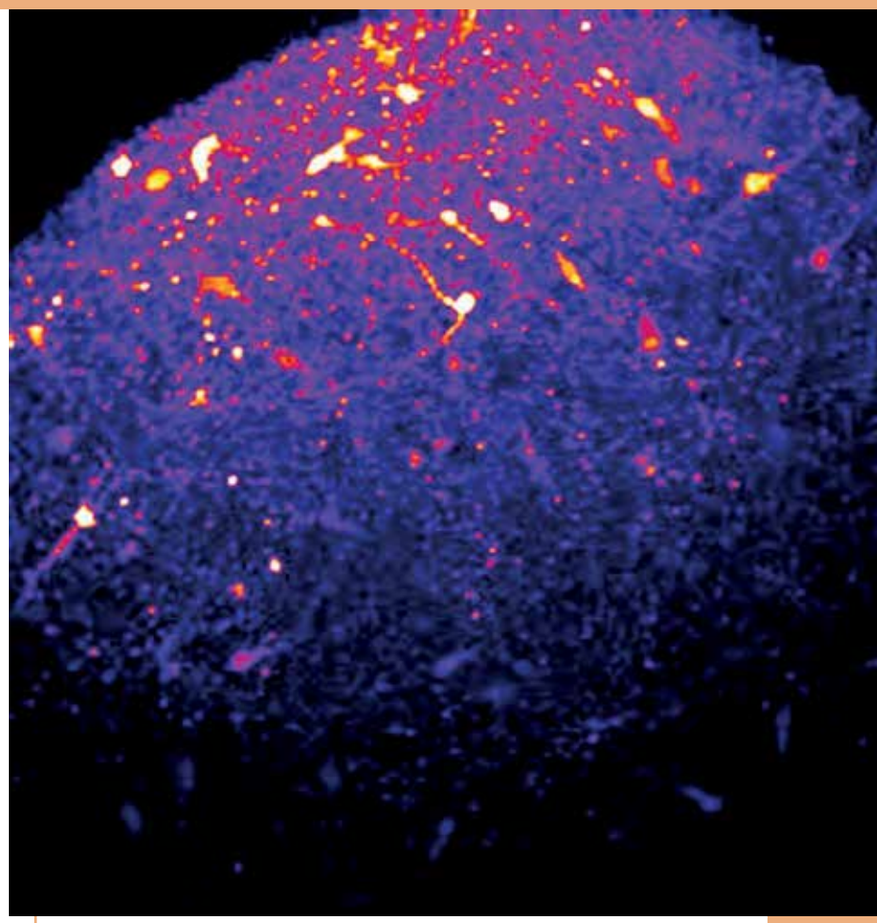
## Emerging Infectious Diseases

The Emerging Infectious Diseases (EID) Programme was established to facilitate the development of a world-class regional infectious disease centre for reference and research in the region. Its research covers all major areas of emerging infectious diseases, from pathogen discovery, molecular pathogenesis, immunology to experimental therapeutics, clinical trials of vaccines and therapeutics and global health research. Partnerships with NUS; SingHealth; National Centre for Infectious Diseases; Singapore General Hospital; A*STAR; Nanyang Technological University, Singapore; Tan Tock Seng Hospital; DSO National Laboratories and Arcturus Therapeutics will aid in the development and discovery of novel methods to treat, control and ultimately prevent new and emerging pathogens.

## Health Services and Systems Research

▲ Research that focuses on the organisation and delivery of health and social services in the context of an ageing population.

The Health Services and Systems Research (HSSR) Programme at Duke-NUS has been a leader in the study of health systems and services for the population in Singapore and beyond. Its key goals are to show whether health and related services are effective, appropriate, scalable and economically sustainable. The Programme facilitates and advances a multi-disciplinary research agenda by actively engaging the government, regional health systems and social service organisations. Research methods applied in HSSR include implementation science, health economics, decision science, survey/qualitative research, quantitative medicine, epidemiology and data science.



▲ Altered network activities in UBE3A KO induced cortical organoids.

*Photo credit: Dr Masahiro Fukuda, NBD Programme*

## Neuroscience and Behavioural Disorders

The Neuroscience and Behavioural Disorders (NBD) Programme is focused on understanding the structure and function of the nervous system, and the neural mechanisms underlying human neurological, psychiatric and ophthalmological disorders. Collaborating with the clinical faculty at Singapore General Hospital, the National Neuroscience Institute, the Institute of Mental Health and the Singapore Eye Research Institute (SERI), the Programme has a strong footing in neurodegenerative diseases, cognitive disorders, developmental disorders and diseases of the neural retina. It aims to ultimately unravel the secret behind human intelligence and translate discoveries into diagnostic and therapeutic strategies in brain disorders such as autism, Parkinson's disease and dementia.

# *RESEARCH CENTRES*

In addition to our five Signature Research Programmes that aim to make a substantive impact on Singapore's biomedical sciences scene, we also have eight medical research centres that further integrate and enhance research and learning at Duke-NUS through collaborations with leading institutions and agencies locally and globally.

▼ The CCSD team.

## 1 Centre for Clinician-Scientist Development (CCSD)

The Centre for Clinician-Scientist Development (CCSD) supports the research pillar of academic medicine in our SingHealth Duke-NUS Academic Medical Centre (AMC) by nurturing passionate and talented clinician scientists. The Centre provides support for aspiring clinician scientists at the developmental stage of their research career, through personalised career guidance and structured training geared towards improving research and leadership skills.

▲ The LCPC team.

## 2 Lien Centre for Palliative Care (LCPC)

The Lien Centre for Palliative Care (LCPC) is the first of its kind in Asia, established with the goal of being the leading academic centre delivering and facilitating palliative care research and education in Singapore and the region. LCPC caters to the physical, psychological and social needs of individuals living with a life-limiting condition, by nurturing a pool of palliative healthcare professionals to enhance service delivery through training programmes and research.

## 3 Centre for Vision Research (CVR)

Established in partnership with the Singapore Eye Research Institute and Singapore National Eye Centre, the Centre for Vision Research (CVR) focuses on understanding the causes of blinding diseases and developing novel treatments for the same. Leveraging the laboratory, clinical and genetics research of Duke-NUS and partner organisations, the Centre aims to innovate ways to maintain and restore vision.

## 4 Centre for Computational Biology

The Centre for Computational Biology provides expertise in computational biology and bioinformatics. The Centre's researchers are especially adept at integrated analyses for omics studies and systems biology approaches, and pursue projects with significant impact on the scientific community.

## 5 Centre for Quantitative Medicine (CQM)

The Centre for Quantitative Medicine (CQM) serves as the home for biostatistics and related disciplines like epidemiology at Duke-NUS. It was formed to engage in applied biostatistics research, provide teaching and training in biostatistics and provide biostatistical support to clinician scientists and other researchers in the SingHealth Duke-NUS Academic Medical Centre (AMC).

## 6 Centre of Regulatory Excellence (CoRE)

The Centre of Regulatory Excellence (CoRE) is the first dedicated Asian Centre targeted at meeting the needs of national health regulators, the biomedical industry, researchers and academics. Guided by its mission, CoRE contributes to improving patient access to health products, and enhancing regional health systems and health security. The Centre is gaining increasing recognition for its education programmes and as a neutral, academic convener of dialogues, seminars and round tables involving international thought leaders in health regulation and healthcare systems.


▼ CoRE's 5th anniversary dinner and graduation celebration.

▲ The CARE team.

## 7 Centre for Ageing Research and Education (CARE)

The Centre for Ageing Research and Education (CARE) was established with the aim of developing a consolidated, long-term approach towards meeting the challenges of an ageing population. Drawing on its interdisciplinary expertise and collaborations across medical, social, economic and environmental perspectives, the Centre conducts leading-edge research on the health and social determinants of successful ageing. CARE also invests heavily in education and actively engages with government and industry partners to identify needs and strategies to enhance the experience of ageing.

## 8 Pre-Hospital and Emergency Research Centre (PERC)

Established through a collaboration between Duke-NUS, the Unit for Pre-hospital Emergency Care of the Ministry of Health Singapore (MOH), SingHealth Duke-NUS Emergency Medicine Academic Clinical Programme (EM ACP) and the Ministry of Home Affairs (MHA) Singapore Civil Defence Force, the Pre-hospital and Emergency Research Centre (PERC) aims to address urgent issues facing our pre-hospital and emergency care system. The experts will focus on the development of strategies to better integrate pre-hospital, in-hospital, and community care by applying robust research techniques to real-world clinical data.

# *Making Waves*
## — CTeD Start-Ups

In the world of basic and clinical science, potentially life-changing discoveries and innovations often remain underdeveloped or cannot be commercialised to achieve their full potential. Through the establishment of CTeD in the Office of Innovation and Entrepreneurship, Duke-NUS aims to provide its faculty with resources, expertise and support to facilitate the identification, protection and translation of healthcare innovations arising in the School.

Research at Duke-NUS is optimised through its wide variety of programmes, institutes and collaborations, which help to translate discoveries and innovations into commercial applications that can enhance healthcare and improve the lives of not only patients, but also the general population. CTeD works closely with Duke-NUS researchers, as well as government agencies, universities and private companies to translate research outcomes into impactful technologies that can be developed and commercialised to benefit the population in Singapore and beyond.

### Achievements Through The Years

**>170** SYNERGISTIC RESEARCH ALLIANCES

**149** NEW PATENT FILINGS

**22** LICENSING AGREEMENTS EXECUTED

**73** PATENTS AWARDED

**16 START-UP COMPANIES**

**176** INVENTION DISCLOSURES SUBMITTED BY DUKE-NUS INVESTIGATORS

**COMPANIES**

### Some of Our Start-Ups

**CognaLearn**

A learning-science company that uses InteLearn™, a proprietary patented method developed at Duke-NUS Medical School, to optimise learning based on cognitive science.

**ENLEOFEN**

Established to develop first-in-class antibody therapeutics for the treatment of human fibrotic diseases; in December 2019, sold its intellectual property assets to German pharmaceutical company Boehringer Ingelheim for clinical development.

**TRAVECTA THERAPEUTICS**

A biotech company that utilises its novel Blood-Brain Barrier (BBB) Transport Platform to facilitate the transport of compounds across the BBB for the treatment of central nervous system disorders.

**Neurobit Technologies**

Using a sleep analytics technology, the company harnesses stage sleep data for the treatment of sleep apnoea.

**evecxia therapeutics**

A clinical stage pharmaceutical company that develops and commercialises new formulations for the treatment of depression and other neurological diseases.

**MOGRIFY Transforming Cell Therapy**

Uses a network-based algorithm to find transcription factors that impart the most influence on changes in cellular state, which can be used in various medical research applications.

**Vanteres**

Develops diagnostic tests and products to provide solutions for high-risk pregnancies, pre-term or small-for-gestational-age infants, and cognitive development of infants and young children.

# *Aptitude And Attitude*
## — Our Student Body

Duke-NUS welcomes students from all walks of life, across different age groups and ethnicities, spanning various educational disciplines and career backgrounds. Our diverse, multi-ethnic student body is encouraged to embrace their myriad life experiences throughout their education journey as they are nurtured to their fullest potential to become future clinician leaders, scientists, entrepreneurs, educators and more.

Our students relive fond memories of the strong bonds they have formed during their time on campus, and share the growth and development they have undergone through the years.

*p.23* **Lim Mei Chee**

*p.24* **Dr Jacelyn Lim**

*p.25* **Tan Kai Wei and Chia Xintian**

*p.26* **Chan Jia Jun, Ebenezer**

*p.27* **Nurul Ain Binte Rejap**

*p.28* **Onittah Lola Nair**

*p.29* **Dr Kenneth Chin**

*p.30* **Dr Deepali Bang**

## Lim Mei Chee

- Best poster presentation, Duke-NUS PhD Student Research Symposium 2019
- Secretary of the PhD Student Council (2019–present)
- BA in Cell and Systems Biology, University of Oxford (2012–2015)

Duke-NUS paves the way for future research through effective cultivation of students and early career scientists.

PhD Intake
2017

MD Class of
2013

## Dr Jacelyn Lim

- Senior Resident, Ophthalmology, SingHealth
- BEng in Bioengineering, National University of Singapore (2004–2008)

Duke-NUS has been a life-changing and holistic experience. It has nurtured my passion for medicine, forged concrete friendships, and created a strong sense of camaraderie.

## Tan Kai Wei

- Co-director, Project DOVE 2019
- Champion, Minnie Pang Pathology Challenge Shield 2019
- BSc (Hons 1st Class) in Biological Sciences, Nanyang Technological University, Singapore (2011–2015)

## Chia Xintian

- Duke-NUS Achievement Prize: Top Score in the Second Year Clinical Skills Examination
- Runner-up, Original Research Poster Category, Association of Anaesthetists of Great Britain & Ireland Annual Congress 2018
- BSc (Hons 1st Class) in Biological Sciences, Nanyang Technological University, Singapore (2011–2015)

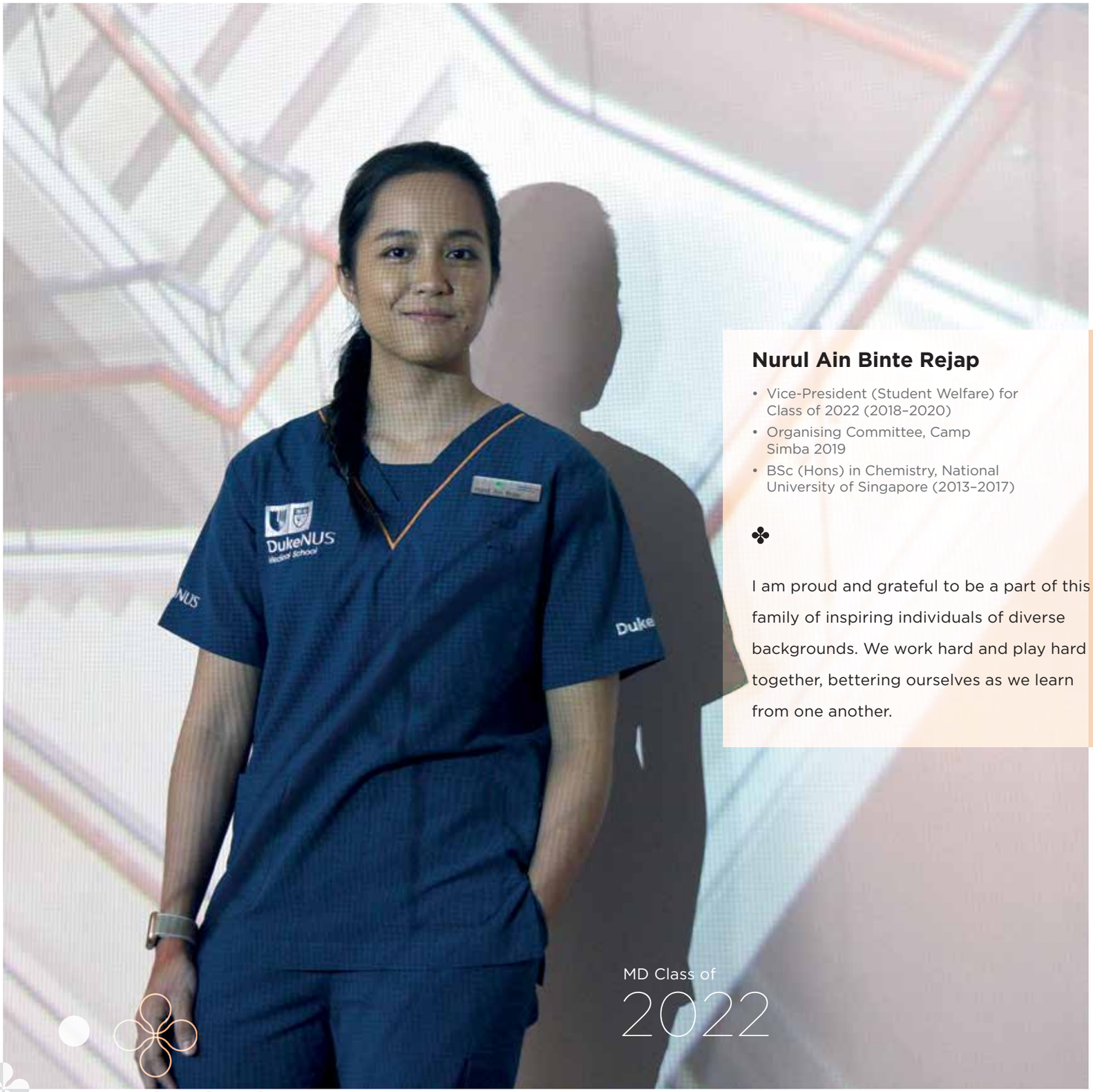
Medical training is tough and emotional support is crucial. We are fortunate to have each other on this journey and are thankful to work alongside many other like-minded and inspiring individuals.

*Kai Wei and Xintian are engaged to be married.*


## Chan Jia Jun, Ebenezer

- BSocSci (Hons with Distinction) in Psychology, Nanyang Technological University, Singapore (2015–2019)

There's a unique atmosphere on campus, and I've felt at home since day one. My team is my second family, the faculty is incredible, and there are so many moments that make life at Duke-NUS never boring.




## Nurul Ain Binte Rejap

- Vice-President (Student Welfare) for Class of 2022 (2018–2020)
- Organising Committee, Camp Simba 2019
- BSc (Hons) in Chemistry, National University of Singapore (2013–2017)

I am proud and grateful to be a part of this family of inspiring individuals of diverse backgrounds. We work hard and play hard together, bettering ourselves as we learn from one another.

MD Class of
2022

MD Class of
# 2021

## Onittah Lola Nair

- President of Neurosurgery Student Interest Group (2020–2021)
- President of Neurology Student Interest Group (2019–2020)
- BSc (Hons) in Biomedical Science, National University of Singapore (2012–2016)

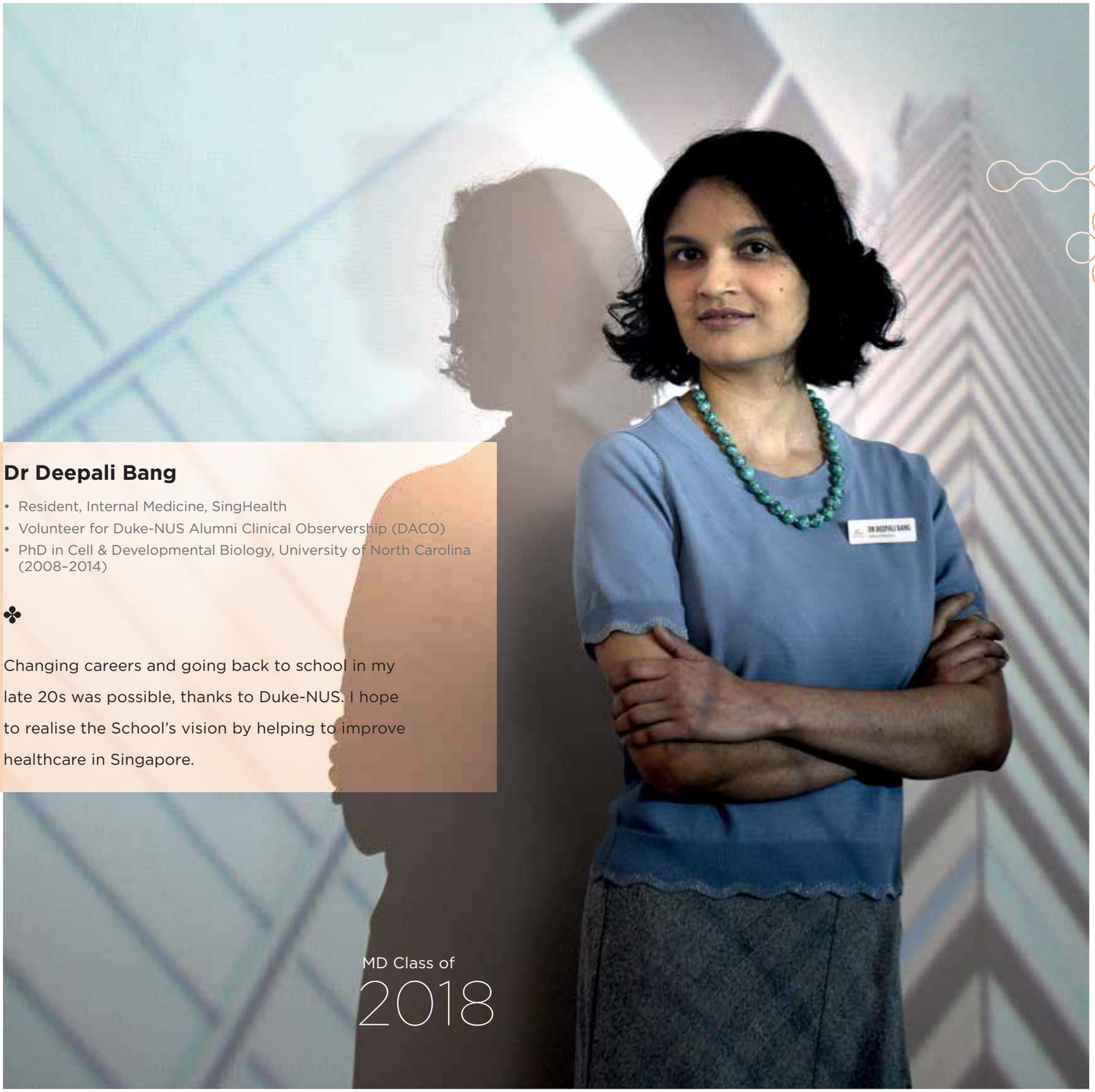
We are a family of lifelong friends helping one another become the best doctors that we can be. This tradition of paying forward is one that defines what it means to be a Dukie.

## Dr Kenneth Chin

- Resident, Diagnostic Radiology, SingHealth
- Secretary, Duke-NUS Medical Alumni
- BSc in Biochemistry & Molecular Biology Research, University of Melbourne (2005–2008)

Duke-NUS showed me how education and nurturing act as a force multiplier in healthcare advancement. Similarly, I aspire to make education and mentorship an integral part of my medical career.

MD Class of
2016



## Dr Deepali Bang

- Resident, Internal Medicine, SingHealth
- Volunteer for Duke-NUS Alumni Clinical Observership (DACO)
- PhD in Cell & Developmental Biology, University of North Carolina (2008–2014)

Changing careers and going back to school in my late 20s was possible, thanks to Duke-NUS. I hope to realise the School's vision by helping to improve healthcare in Singapore.

MD Class of
2018

# *Bridging Knowledge*

## — SingHealth Duke-NUS Academic Medical Centre

The Academic Medicine partnership between Duke-NUS and SingHealth began in 2005, in the same year the School was founded. As the largest public healthcare cluster in Singapore, SingHealth provides a real-world setting for the development of research and education at Duke-NUS. Officially endorsed by the SingHealth Board of Directors and Duke-NUS Governing Board with an MOU signing ceremony in 2010, the SingHealth Duke-NUS Academic Medical Centre (AMC) functions as a synergistic model of collaboration, integrating novel clinical and translational research with patient care and delivery systems.

Duke-NUS' prime location within SingHealth's Singapore General Hospital Campus allows clinicians, faculty, staff and students to tap on the collective expertise, experience and knowledge of both institutions and make a significant difference in medical education, research and clinical care, leading to improved healthcare and patient outcomes. The education and research endeavours under the AMC are supported by the Academic Clinical Programmes, SingHealth Duke-NUS Joint Institutes and Centres, as well as SingHealth Duke-NUS Disease Centres.

The SingHealth Duke-NUS AMC facilitates a vibrant and cohesive environment that encourages new discoveries and innovations in healthcare. The collaboration was further strengthened in 2018, with the opening of the AMC Link Bridge, which provides a new pathway between Duke-NUS and SingHealth's Academia. The bridge was formally opened on 26 November 2018, with a ribbon-cutting ceremony officiated by Guests-of-Honour Professor Thomas Coffman, Dean, Duke-NUS, and Professor Ivy Ng, Group CEO, SingHealth.

## Academic Clinical Programmes (ACPs)

Integrated frameworks designed to support our vision towards Academic Medicine are created for the 15 clinical specialties, harnessing the expertise of each discipline across SingHealth and Duke-NUS for greater synergy in clinical care, education and research.

- Anaesthesiology and Perioperative Sciences
- Cardiovascular Sciences
- Emergency Medicine
- Family Medicine
- Medicine
- Musculoskeletal Sciences
- Neuroscience
- Obstetrics and Gynaecology
- Oncology
- Ophthalmology and Visual Sciences
- Oral Health
- Paediatrics
- Pathology
- Radiological Sciences
- Surgery

## SingHealth Duke-NUS Joint Institutes & Centres

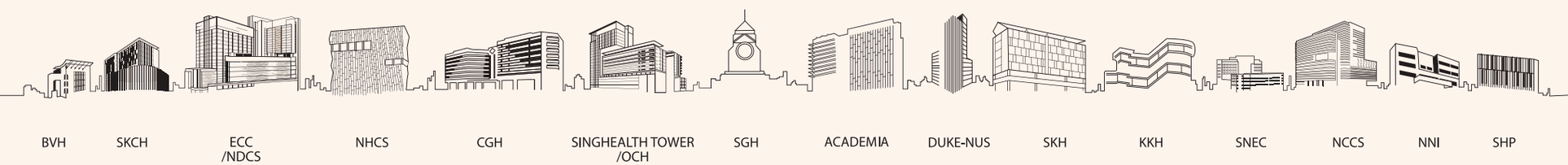
Through Joint Institutes and Centres, we invest in translational and clinical research platforms to deliver world-class scientific discoveries and solutions for preventing and treating diseases relevant to the region.

- Academic Medicine Education Institute (AM•EI)
- Academic Medicine Research Institute (AMRI)
- Health Services Research Institute (HSRI)
- Infectious Diseases Research Institute (IDRI)
- Institute for Patient Safety & Quality (IPSQ)
- Institute of Precision Medicine (PRISM)
- Joint Centre for Technology and Development (Joint-CTeD)
- National Cancer Research Institute Singapore (NCRIS)
- National Dental Research Institute Singapore (NDRIS)
- National Heart Research Institute Singapore (NHRIS)
- National Neuroscience Research Institute Singapore (NNRIS)
- SingHealth Duke-NUS Global Health Institute (SDGHI)
- Translational Immunology Institute (TII)
- Viral Research and Experimental Medicine Centre (ViREMiCS)

## SingHealth Duke-NUS Disease Centres (SDDCs)

SDDCs focus on disease-based outcomes that benefit from multi-disciplinary coordination for training, research and clinical service; enabling patients to receive integrated, holistic care from a broader base of healthcare professionals without the need to travel to multiple institutions.

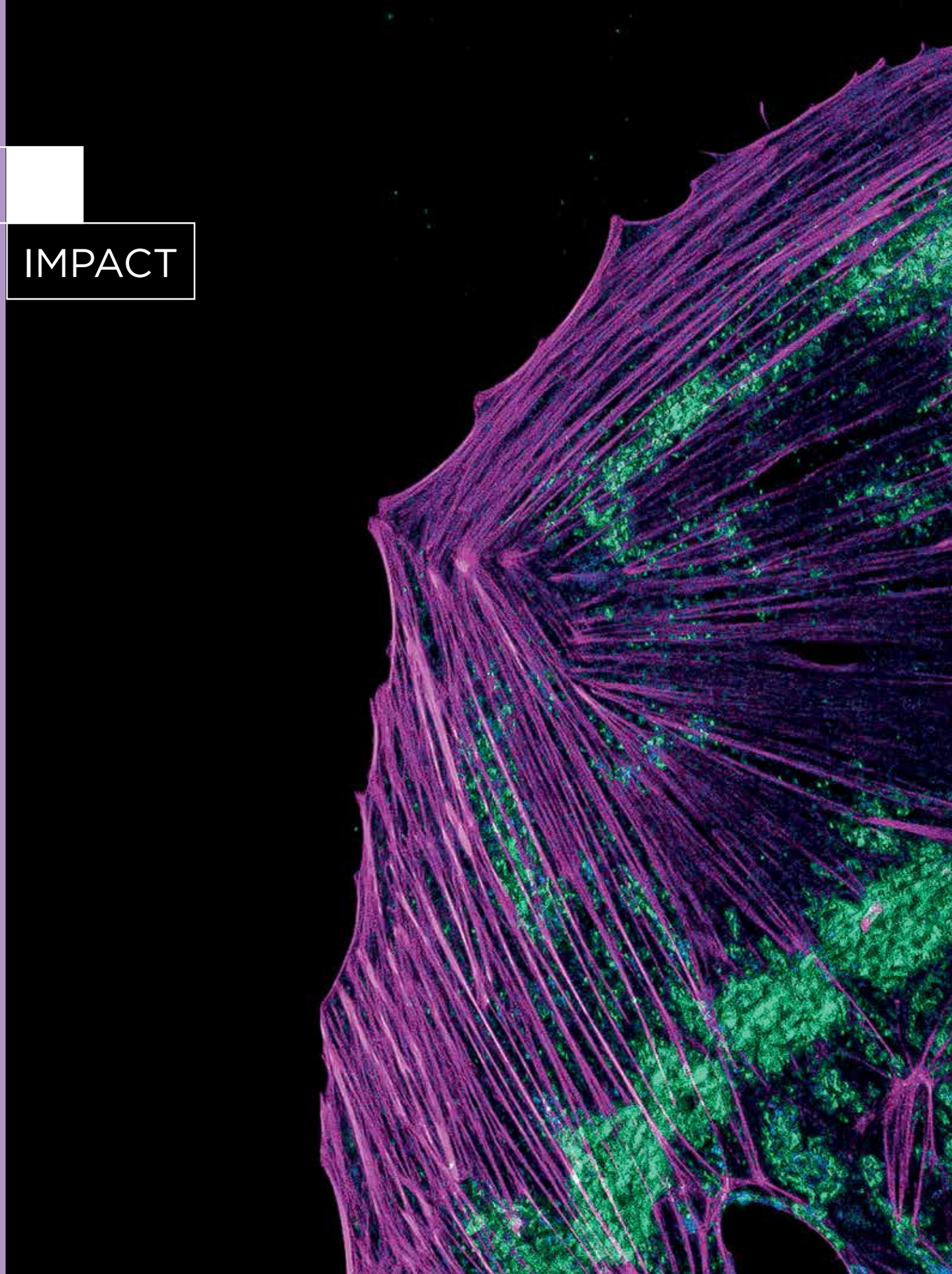
- SingHealth Duke-NUS Blood Cancer Centre
- SingHealth Duke-NUS Breast Centre
- SingHealth Duke-NUS Diabetes Centre
- SingHealth Duke-NUS Genomic Medicine Centre
- SingHealth Duke-NUS Head & Neck Centre
- SingHealth Duke-NUS Lung Centre
- SingHealth Duke-NUS Memory & Cognitive Disorder Centre
- SingHealth Duke-NUS Sleep Centre
- SingHealth Duke-NUS Sport & Exercise Medicine Centre
- SingHealth Duke-NUS Supportive & Palliative Care Centre
- SingHealth Duke-NUS Transplant Centre

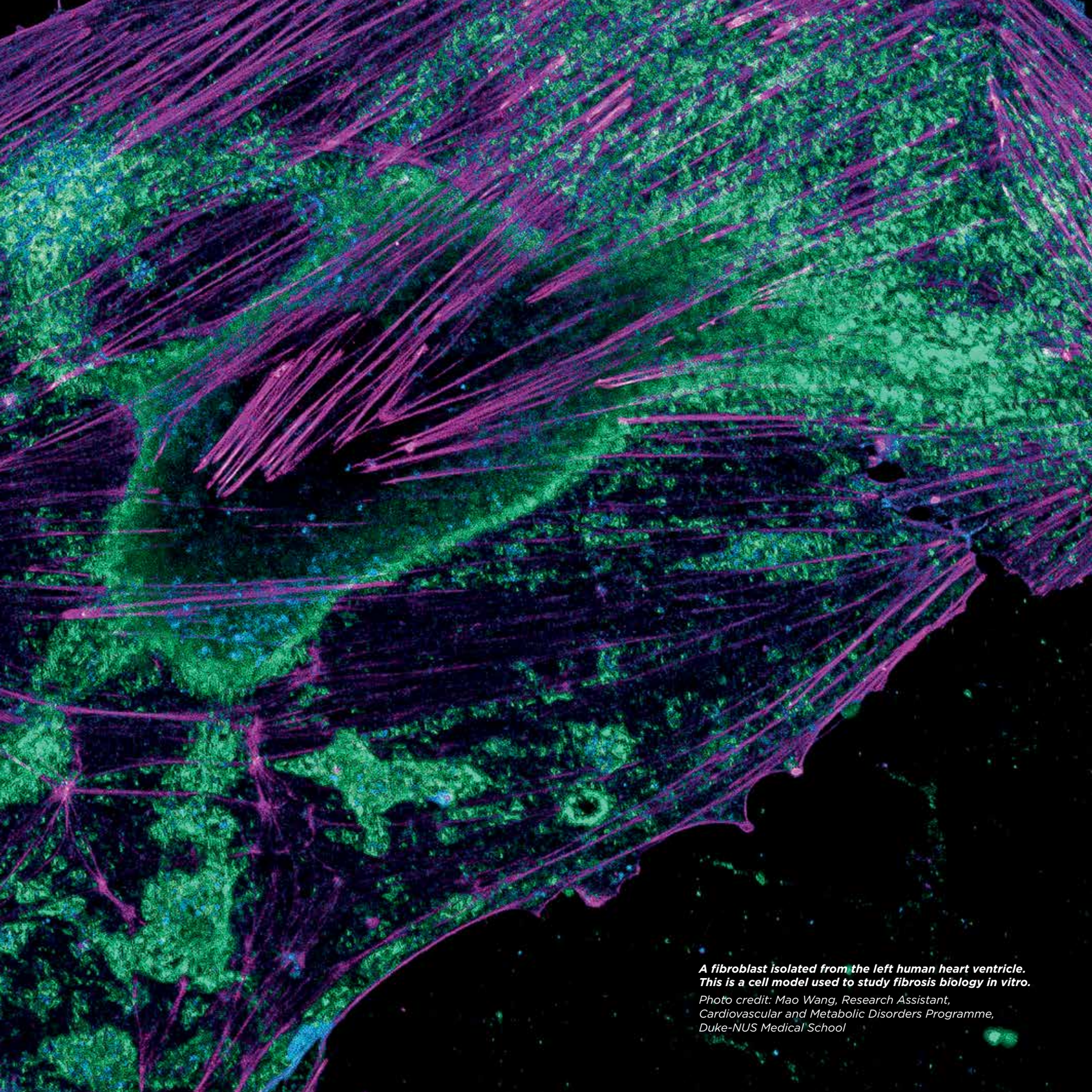



◀ Professor Ivy Ng and Professor Thomas M Coffman officially opened the AMC link bridge on 26 November 2018.

# A LASTING IMPACT

As medical professionals, Duke-NUS clinician scientists and researchers innovate with a purpose — to impact change in the wider healthcare community. Through commercialisation of revolutionary research breakthroughs, Duke-NUS clinician scientists are dedicated to improving patient care outcomes and creating a healthier population in and out of Singapore.



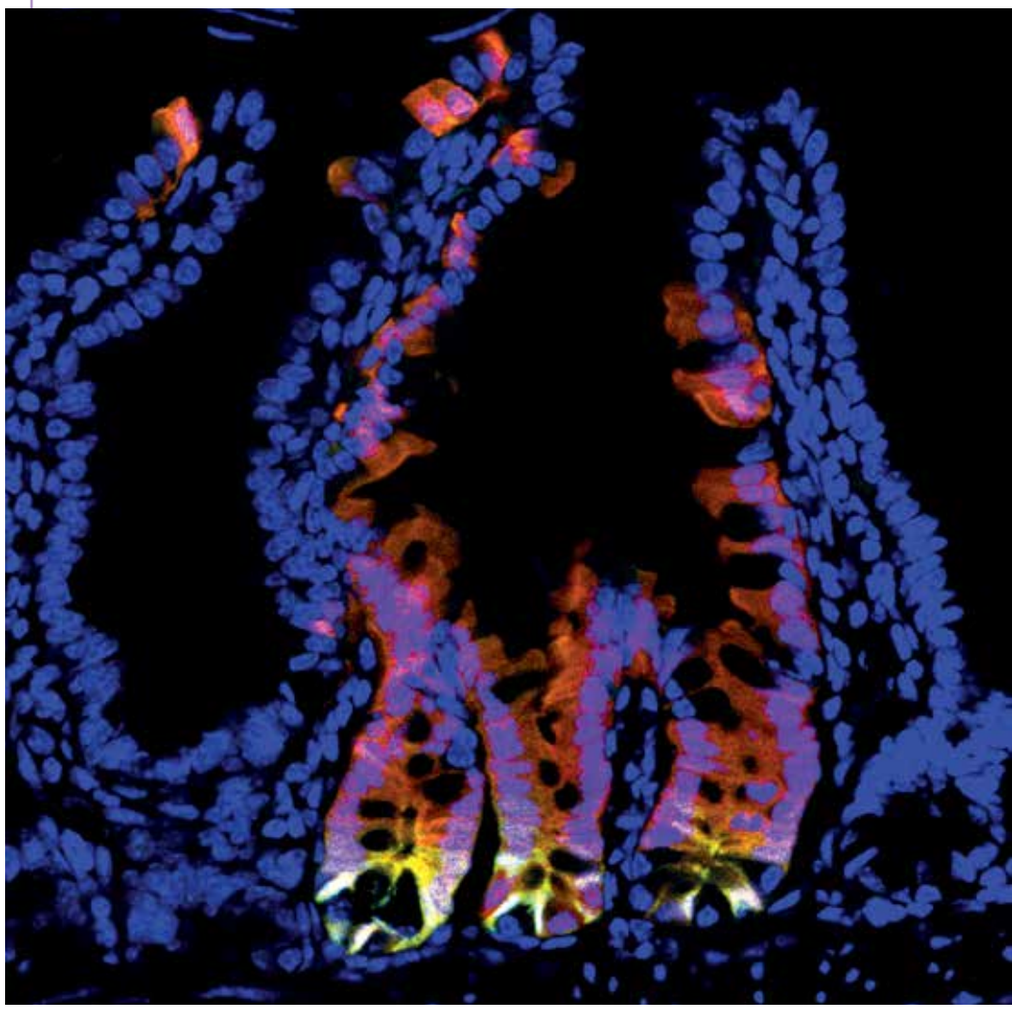


***A fibroblast isolated from the left human heart ventricle. This is a cell model used to study fibrosis biology in vitro.***

*Photo credit: Mao Wang, Research Assistant, Cardiovascular and Metabolic Disorders Programme, Duke-NUS Medical School*

# *Exploring Endless Possibilities*
## — 15 Impactful Research Projects

▼ Endogenous Wnt signalling drives the proliferation of intestinal crypts and maintains stem cell self-renewal.



## 1

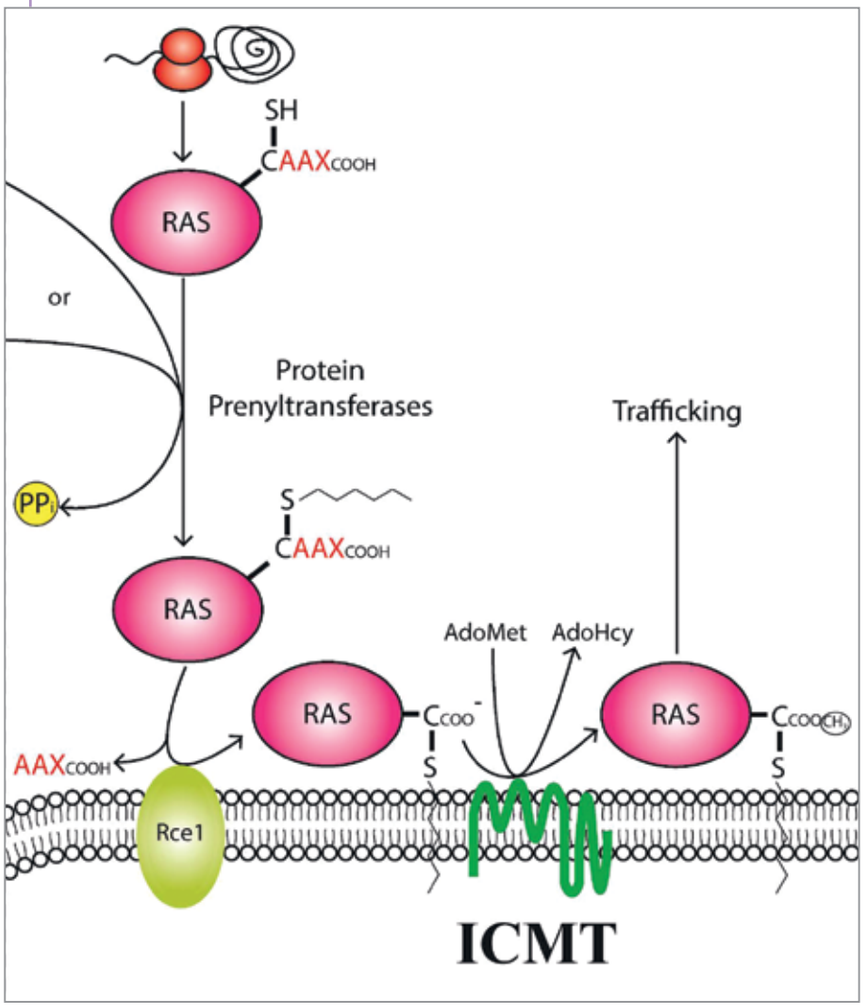
### A Drug to Inhibit Wnts

Cancer is a disease of mutations, and modern cancer therapy seeks to specifically target abnormal pathways while sparing normal functions. In this way, cancer growth can be blocked, while minimising unpleasant side effects.

Based on the discovery work of Professor David Virshup from Duke-NUS, a team of researchers from Duke-NUS and A*STAR undertook research on Wnt secretion inhibitors. This collaborative work led to the development of ETC-159, a novel cancer drug for the treatment of a variety of cancers, including colorectal, ovarian and pancreatic cancers.

ETC-159 is effective in the laboratory at treating cancers with specific mutations in the Wnt signalling pathway. Because of its promise, it is in clinical trials in Singapore and abroad, testing whether it will help patients with Wnt-mutant cancers. ETC-159 has also shown to decrease proliferation in other tissues, such as in experimental renal fibrosis.

▼ RAS protein post-translational modification. Wang & Casey, 2016, *Nature Reviews Molecular and Cellular Biology*




## 2 ICMT Research for Potential New Cancer Treatment Approach

Mutations of RAS proteins directly cause more than 30 per cent of all human cancers. These RAS-driven cancers, including most pancreatic cancers and many colon and lung cancers, as well as forms of leukaemia, are among the most difficult to treat. Scientists have worked diligently over the past 30 years to find inhibitors for RAS proteins. However, despite extensive effort, there has been limited success, primarily because the unique chemical properties of RAS proteins make it very difficult to directly turn them off. For this reason, scientists began to look at other ways to inhibit RAS proteins, such as enzymes that modify RAS.

One of the most important enzymes that modify RAS is isoprenylcysteine carboxylmethyltransferase (ICMT). The research team led by Associate Professor Mei Wang, in collaboration with Professor Patrick Casey, has focused on the critical role of ICMT in the modification of RAS proteins, with the ultimate goal of treating RAS-driven cancers by selective inhibitors of ICMT. The team's work has led to the conclusion that chemical modification by ICMT is essential for RAS function in cancer.

Multiple studies from the Wang Lab have shown that inhibition of ICMT can halt cancer formation as well as progression to metastatic disease. In addition to the three isoforms of RAS proteins, ICMT also impacts the processing and functions of several other members of the RAS superfamily that are important in cancer progression. The team found that ICMT regulates important cellular processes such as cell metabolism, vesicular transport, cell movement and even survival. Assoc Prof Wang's and Prof Casey's research led to a collaboration with A*STAR's Experimental Therapeutics Centre to discover some of the most potent ICMT inhibitors known. The work by Assoc Prof Wang and her colleagues on ICMT has generated broad interest in RAS therapy development in the battle against cancer.


◀ The winning team of scientists from Duke-NUS, National Cancer Centre Singapore, Genome Institute of Singapore, as well as Japan, Taiwan and Thailand.

## 4

## American Association for Cancer Research Team Science Award

For the first time since its inception, the American Association for Cancer Research (AACR) Team Science Award was conferred to an Asian team of cancer researchers in 2018, comprising researchers from Duke-NUS, National Cancer Centre Singapore, Genome Institute of Singapore and collaborators from Japan, Taiwan and Thailand. The prestigious award honours impactful groundbreaking cancer research.

Focusing on cancers predominantly found in Asia, the team studied a plethora of cancers from gastric cancer to little known cancers such the Asian prevalent T cell lymphomas and bile-duct cancers, forming a hypothesis on the link between cancer and the environment.

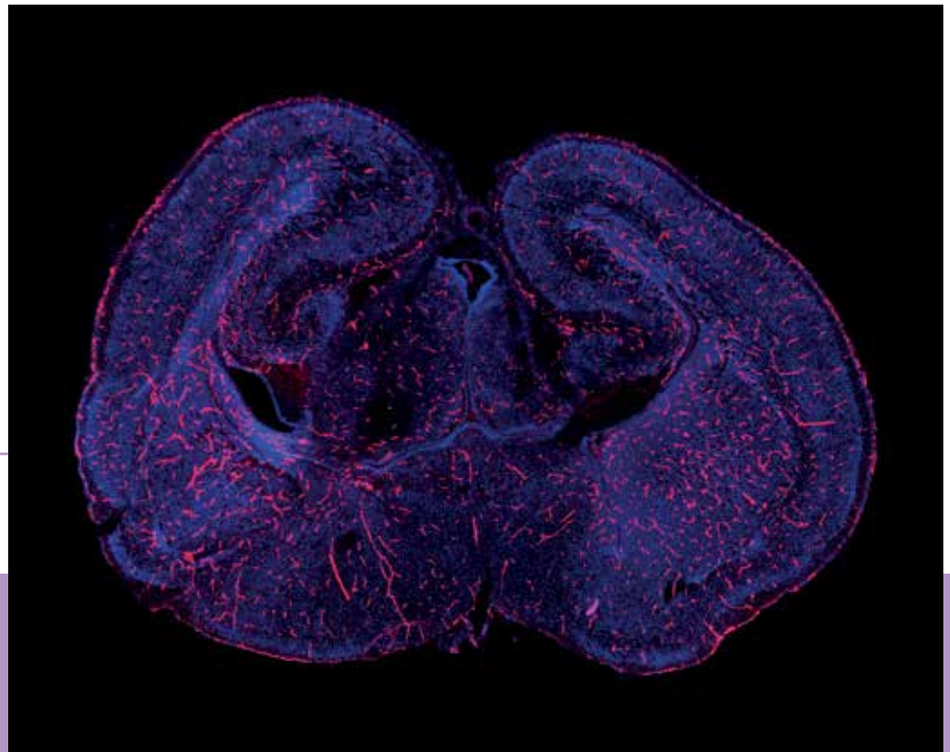
Their research findings helped identify new genes and pathways, such as genetic abnormalities in stomach cancers which often lead to demise. Translating their findings into clinical trials, the team looked into charting new avenues for further therapies, facilitating a better understanding of cancers and enhancements to cancer treatments around the world.

## 3

## Mechanism-Based Molecular Lipid Nutrition and Therapeutics for Healthy Brain Development and Function

In 2014, Professor David Silver from Duke-NUS published his research on lysolipids in brain growth and health. The study's results established a path and transport system that specifically delivers lipids such as docosahexaenoic acid (DHA) to the brain, via Mfsd2a, a transporter protein which carries DHA in the chemical form of lysophosphatidlycholine (LPC).

The intellectual property developed by Prof Silver was licensed to Travecta Therapeutics Pte Ltd and Vanteres Pte Ltd, both CTeD biotech start-ups. Both companies intend to leverage this new knowledge in the collaborative development of novel therapeutic agents that can be selectively delivered across the blood-brain barrier to treat neurological diseases and in the development of lipid-based therapeutics.



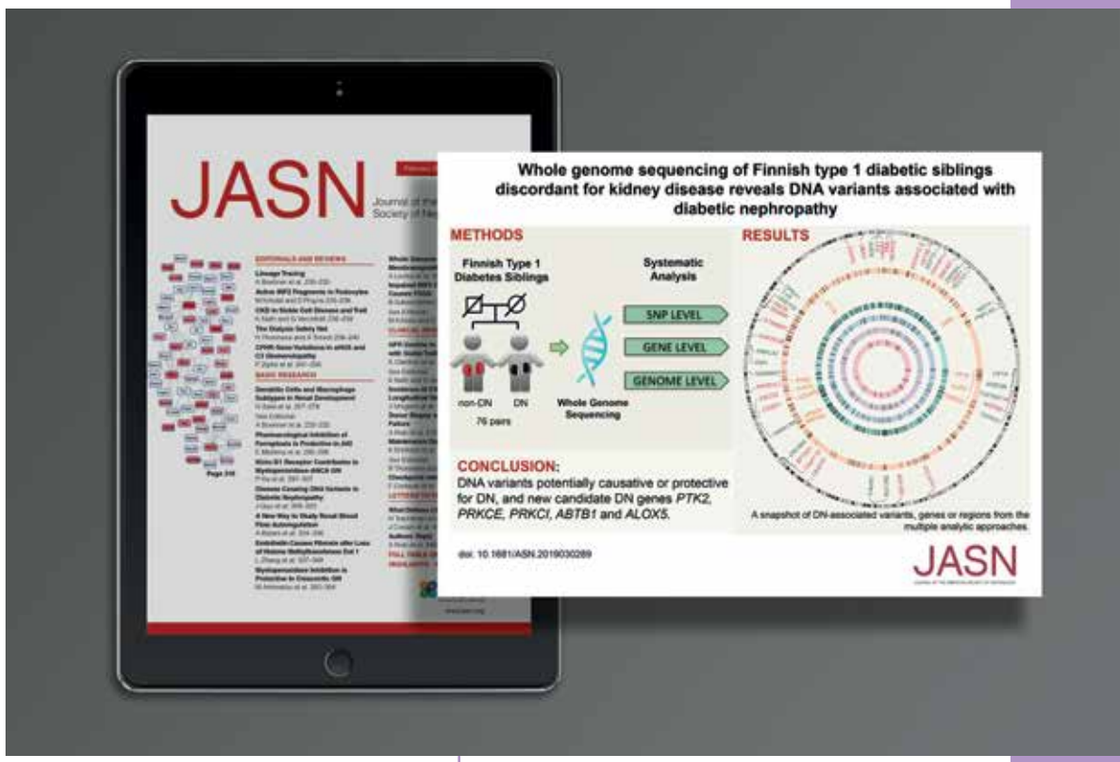
▶ Coronal section of a mouse brain. Mfsd2a (in red) is highly enriched in the endothelial cells that line the microcapillaries of the blood-brain barrier. Hoechst (in blue) is a nuclear stain.

# 5

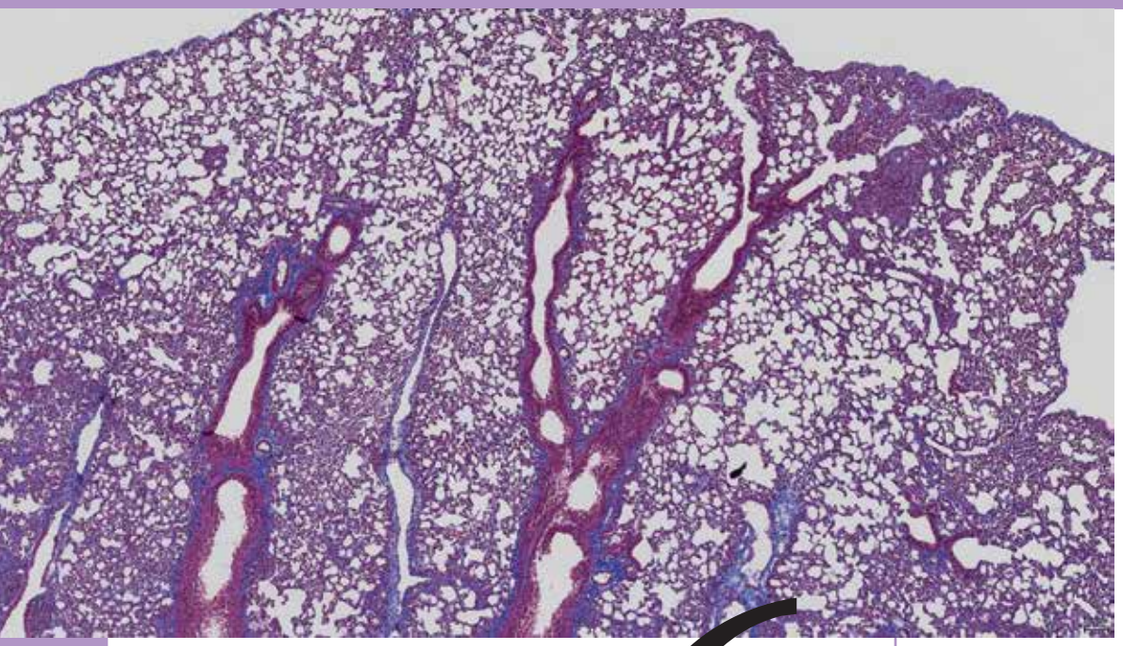
## New Insights on Diabetic Kidney Disease Supported by DYNAMO

Diabetic kidney disease (DKD) is the leading cause of dialysis-dependence in Singapore where the rates of DKD as a cause of end-stage kidney failure are among the highest in the world. The Diabetes StudY in Nephropathy And other Microvascular cOmplications (DYNAMO) was launched in 2017 in support of the Singapore Ministry of Health's War on Diabetes and is focused on addressing the problem of DKD. Led by Professor Thomas Coffman, Dean of Duke-NUS Medical School and a nephrologist, DYNAMO fosters extensive collaborations within the local research community, including NUS Yong Loo Lin School of Medicine, Singapore National Eye Centre, Khoo Teck Puat Hospital, as well as with leading universities such as Duke University in the US, Imperial College London in the UK, the Chinese University of Hong Kong, and University of Sydney in Australia. It aims to reduce the prevalence of DKD in Singapore by 30 per cent in five years. This programme has already produced novel findings, which suggest new potential targets for diagnosis and therapy. For example, researchers have worked for years to develop animal models that accurately mimic the features of human kidney disease, but diabetic mice typically only develop minimal kidney damage. In a 2018 breakthrough, scientists led by Prof Coffman developed a mouse model that successfully emulates human DKD and made the surprise discovery that genes controlling immune and inflammatory responses may play a key role in promoting kidney damage.

In January 2020, a team led by Professor Karl Tryggvason, Tanoto Foundation Professor in Diabetes Research and Associate Professor Enrico Petretto at Duke-NUS' Cardiovascular and Metabolic Disorders Programme, published a study in the *Journal of the American Society of Nephrology* (*JASN*) identifying genes that could be involved in DKD development from analyses of samples from a unique population of Finnish sibling pairs with diabetes, with and without DKD.




▲ Recent research supported by DYNAMO led to new insights that suggest genetic targets for further investigation and was featured on the cover of JASN.



## 6 Translational Discovery Leads to Acquisition of Spin-Out Company to Develop Novel Anti-IL-11 Therapeutics

In a process similar to the formation of scar tissue, fibrosis is the formation of excessive connective tissue that does not heal but instead disrupts the structure and function of the organ and tissue where it forms. The process may affect various tissues within the body and is the main pathology behind heart and renal failure.

Professor Stuart Cook and Assistant Professor Sebastian Schafer from Duke-NUS and National Heart Centre Singapore carried out translational research to identify the key drivers of chronic fibrotic disease in the heart, kidney and other tissues. The results showed that idiopathic pulmonary fibrosis (IPF), a fatal lung disease, may be treated by blocking the protein interleukin-11 (IL-11).

The discovery and subsequently developed technology were licensed to the spin-out company Enleofen Bio, which was subsequently acquired by Boehringer Ingelheim that is advancing anti-IL-11 therapeutics towards treating human fibrotic diseases.

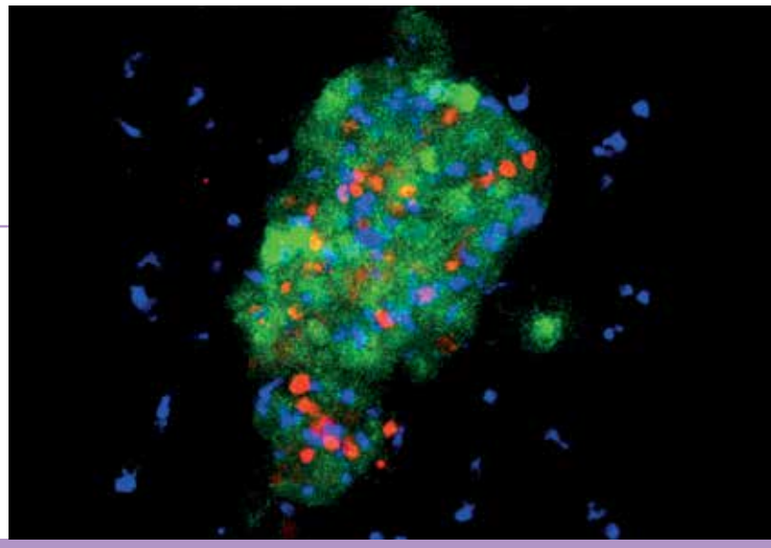
▲ Blocking IL-11 using an anti-IL-11 therapy prevents the activation of lung myofibroblasts and reverses lung fibrosis.

*Photo credit: Dr Benjamin Ng, National Heart Centre Singapore*

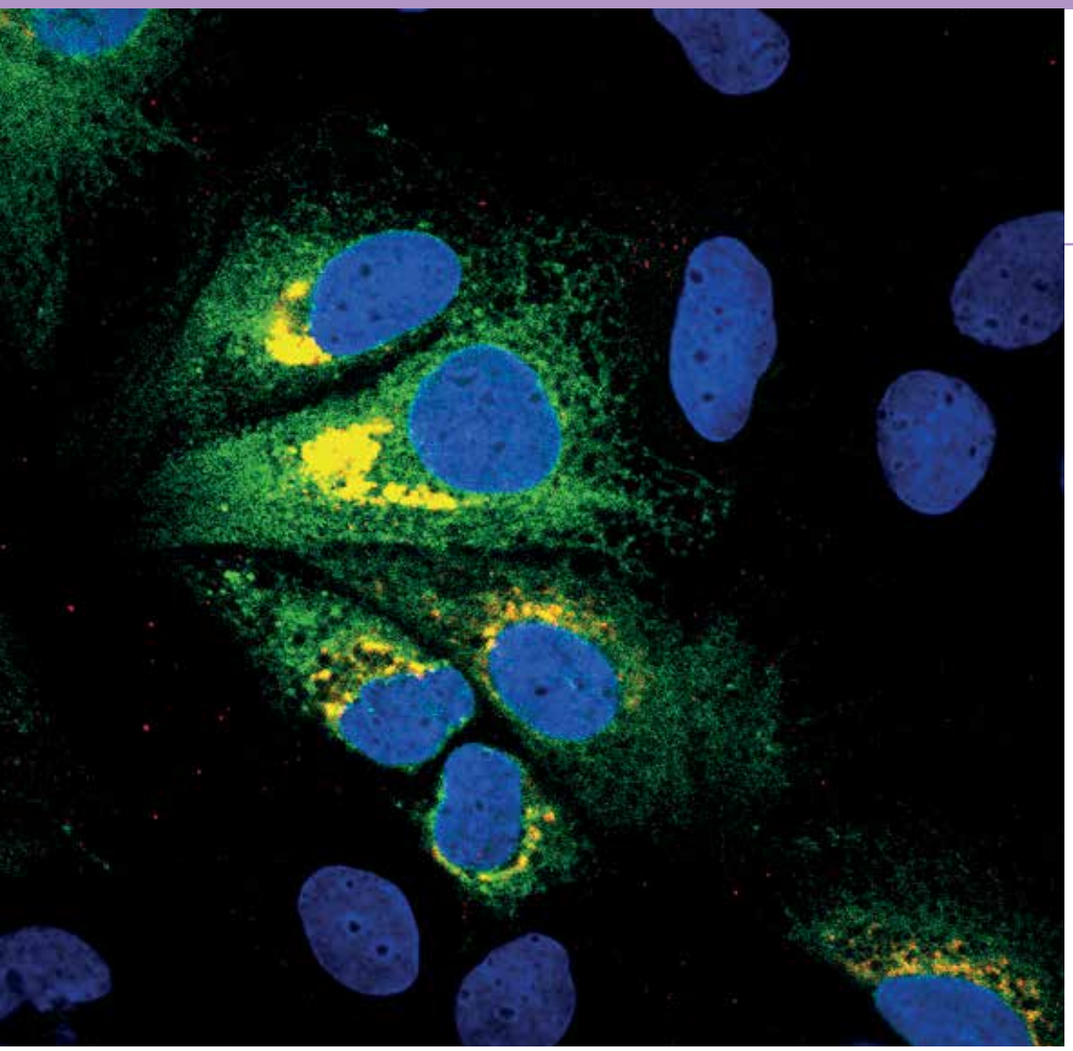
## 7 T Cell Therapy as a Treatment for Hepatocellular Carcinoma

Chronic hepatitis B virus (HBV) infection is a condition predominantly presented in Asian patients, and is highly associated with the development of hepatocellular carcinoma (HCC), a commonly occurring liver cancer. Existing treatments for small to moderate sized HCC are usually restricted to surgery, liver transplantation and loco-regional treatments; while drug-based treatments do not improve prognosis by much when it comes to more extensive cases.

In collaboration with Singapore General Hospital and Lion TCR, Duke-NUS researchers have successfully engineered HBV-specific T cells, a type of immune cells with an ability to kill cancer cells and used these cells to treat HCC. The researchers showed that engineered HBV-specific T cells can recognise HBV proteins expressed on HCC cells derived from their Integrated HBV-DNA, a common feature of HBV-related liver cancer. Upon analysing the specific integration patterns in the HCC cells, researchers then engineered the T cells to destroy the tumour. The treatment is patient-specific, as the engineered T cells are individually engineered and can even reduce the size of tumour lesions in patients with HBV associated liver cancer recurrence.



▶ Image shows an aggregate of HBV-HCC cells (in green) and HBV-specific TCR T-cells (in blue). When the T-cells kill the targets (green), they turn red.



◀ Co-localisation of dengue NS1 (green) with double-stranded RNA (red).

# 8 Vaccine and Therapeutic Antibody Strategies for Mosquito-Borne Viruses

**Zika**
Professor Lok Sheemei's research on the Zika virus has shed some light on the pathology of the virus, with findings providing the world's first high-resolution structure of the virus. The study also delved into the mechanism of neutralisation by antibodies to aid in the development of vaccines and therapeutics.

The results of the study indicate that the Zika virus has a more thermally stable structure than the Dengue virus, consistent with its ability to remain infectious even at extreme, feverish temperatures, and that this stability lent to the structural regions of the virus. Further research demonstrated the highly dynamic nature of DENV 1-4 serotypes, with a human-derived antibody (2D22) shown to successfully kill DENV-2 of all morphologies. These findings can aid in the potential development of vaccines and therapeutics for both Zika and Dengue viruses.

**Dengue**
A team of researchers brought together by a multi-institute collaboration between Duke-NUS, NUS, Nanyang Technological University, Singapore; Massachusetts Institute of Technology (MIT); SMART-MIT and biotech company Visterra looked into the development of a monoclonal antibody which can neutralise all strains of the Dengue virus.

Using a structural-based approach with a naturally occurring antibody with limited reactions toward the virus as a base, the team engineered VIS513, a novel antibody that reacts against all four strains of the Dengue virus. The antibody is in the midst of development by Visterra Singapore International Pte Ltd, with a partnership with D3 of A*STAR for clinical trials next year.

## 9 Incremental Cost-Effectiveness Analysis of Gestational Diabetes Mellitus Screening Strategies in Singapore

Gestational Diabetes Mellitus (GDM) affects about 15 per cent of pregnant women worldwide, with numbers expected to rise within the next decade. Asian women are at greater risk of developing GDM, which poses an increased health risk to both mother and child.

A local study conducted by researchers from KK Women's and Children's Hospital and Duke-NUS found routine screening of pregnant women via an oral glucose tolerance test to be the most effective strategy in enabling earlier detection and intervention of GMD. As previous screening tests targeted at high-risk individuals often failed to identify more than 60 per cent of pregnant women with mild diabetes, routine screening of all pregnant women within 24 to 28 weeks of pregnancy — when symptoms of GMD begin to appear — optimises results.

Early identification of GDM allows for timely medical intervention which can reduce complication rates and health risks by as much as 40 per cent. Diagnosed mothers would then undergo counselling to help monitor and manage their GDM.

▲ Early identification of Gestational Diabetes Mellitus can reduce complication rates and health risks by up to 40 per cent.

▶ The findings were based on research conducted in the Singapore Chinese Health Study led by Professor Koh Woon-Puay.

## 10 Coffee Drinking is Associated with Reduced Risks of End-Stage Renal Disease and Liver Cirrhosis Death

Patients suffering from chronic kidney disease or liver cirrhosis, who worry if they can continue drinking the coffee beverages they enjoy, will be heartened by evidence from studies that have shown an association between coffee drinking and lower risk of end-stage kidney disease and death from liver cirrhosis.

Although many epidemiologic studies have examined the associations between coffee and disease risk in Western populations, few studies have been conducted in Asian populations, among whom coffee consumption is increasing. Given the rise in incidence of end-stage kidney disease and liver cirrhosis deaths in Singapore and globally, and supported by evidence from experimental research, studies on the associations between coffee and risk of these outcomes were conducted in the population-based Singapore Chinese Health Study cohort led by Professor Koh Woon-Puay.

The study showed that compared to non-daily drinkers, those who drank two or more cups of coffee per day had a lower risk of end-stage kidney disease and death from liver cirrhosis. Ingredients in coffee other than caffeine appear to be responsible for the beverage's effect on risk reduction. Since coffee is widely consumed globally, this finding has significant clinical and public-health implications, and provides further impetus to determine the components of coffee that are responsible for the protective effect on kidney and liver health. However, it is too early to recommend the consumption of coffee for health until more thorough data from clinical trials can be obtained.

## The Steps to Avoid Falls in the Elderly Study

# 11

With an ageing population in Singapore, it is essential to structure healthcare around the population's needs. Falls are one of the leading causes of disability and death for the elderly, and are a prevalent occurrence, especially in high-risk individuals recently discharged from the emergency department.

Led by Professor David Matchar, a research team at Duke-NUS partnered Singapore General Hospital, Changi General Hospital and the Agency for Integrated Care to study the effectiveness of tailored physical therapy programmes targeted at preventing falls among the elderly. The Steps to Avoid Falls in Elderly (SAFE) programmes comprised patients above 65 years of age, who had prior medical histories of fall-related injuries.

Through a randomised intervention group and control group, the results show that SAFE slowed physical decline, and reduced the severity of falls. With major comorbidities related to falls among the elderly, it is crucial to implement similar therapy programmes to extend the continuum of care for elderly patients beyond the emergency department.

▼ The Steps to Avoid Falls in Elderly (SAFE) programme has shown to slow physical decline and reduce the severity of falls.

◀ A morning person's body clock runs fast whereas an evening person's body clock runs slow.

## 12 Potential Link between Circadian Rhythms and Metabolic Disorders

Disruption of circadian schedules has been associated with negative cardiometabolic end points, such as metabolic syndrome and dyslipidemia. Chronic circadian misalignment is also believed to contribute to an increased risk of cardiovascular disease and obesity in shift workers.

A group of researchers from Duke-NUS, NUS and National Neuroscience Institute have established a further connection between metabolism and the body's circadian clock — lipids (fat-storing and signalling molecules) in the bloodstream are regulated by the body's circadian clock. The study revealed two different types of people, "morning types" and "evening types", based on the variation in levels of glucose and lipids in their blood at different timings.

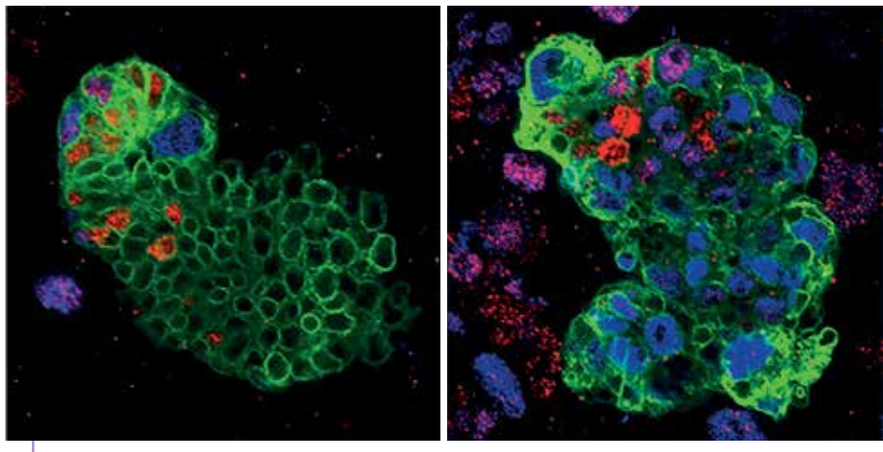
The study raises the possibility that some people are more physiologically suited for shift-work than others, paving the way for further research into why certain individuals are at a higher risk of developing metabolic disorders such as diabetes. Follow-up studies have also been conducted on the effects of sleep deprivation on blood lipid levels and how the time of the day affects lipid concentrations in breast milk.

## 13 Fruit Flies Help Uncover Tumour-Preventing Protein Complex

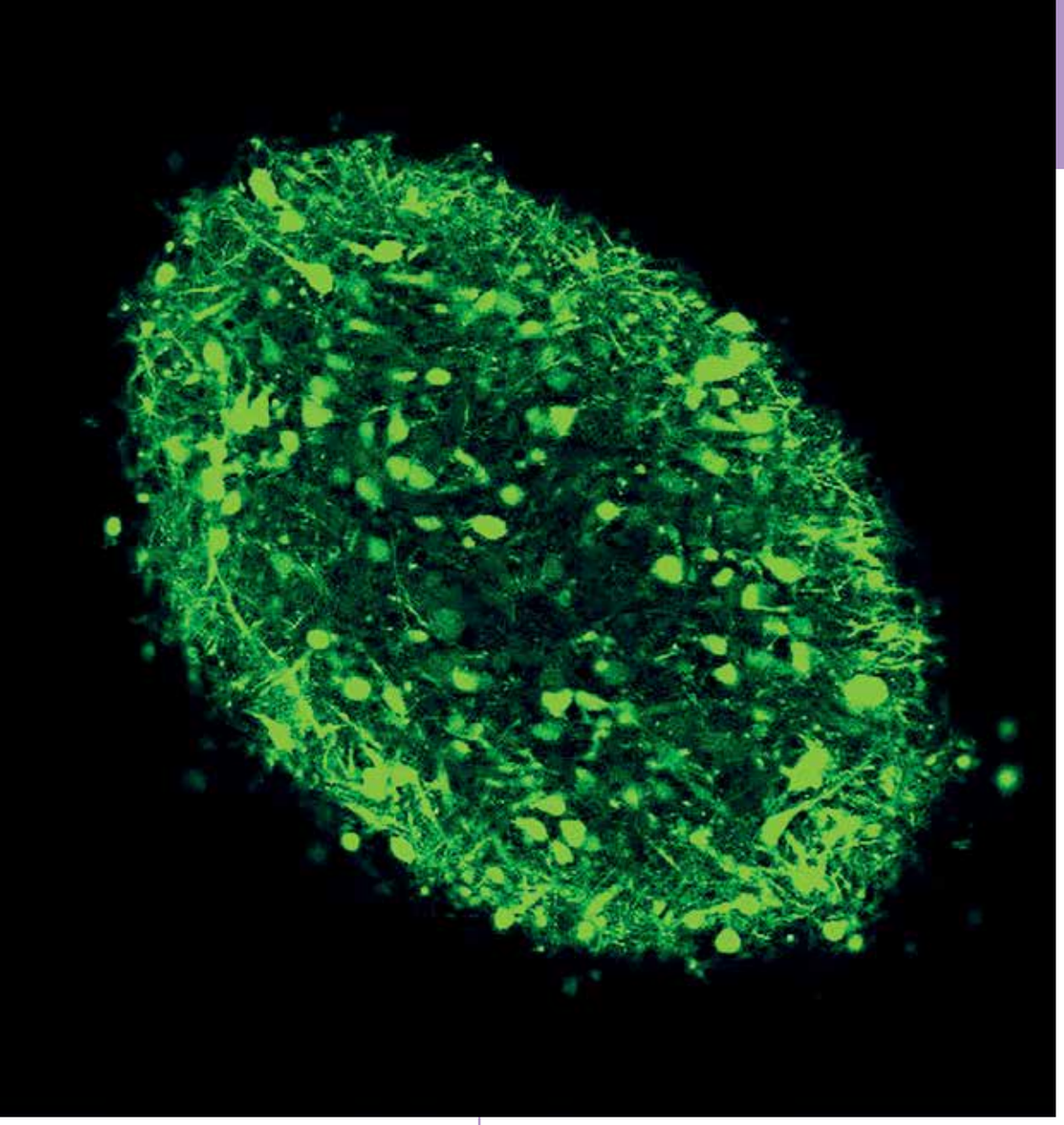
A team of researchers from Duke-NUS, led by Professor Wang Hongyan, have discovered a protein complex in fruit flies that suppresses tumour formation. This protein complex, comprising Brahma, HDAC3 and Earmuff, disrupts dedifferentiation, also known as reversion, a process which is known to promote tumour development through leading progenitor or mature cells to become ectopic neural stem cells.

Using the fruit fly (*Drosophila melanogaster*) model, the team studied neural stem cells (NSC) — multi-potent cells key to brain and nervous system functions — in larval brains to gain a better understanding of stem cell behaviour. Their research showed that type II neuroblasts found in fruit flies bear semblance to human NSCs, providing novel insight into how human NSCs may function.

With a deeper understanding of NSCs, further research can be undertaken in developing therapies and treatments that target tumour prevention, and pave the way for further development of future cancer therapies.



▲ Wild type (left) versus mutant with brain tumour (right).



▲ WT cortical organoid stained with calcium indicator Fluo-4 AM.

## Modelling Human Developmental Disorders Using Human Neural Cells and Brain Organoids

# 14

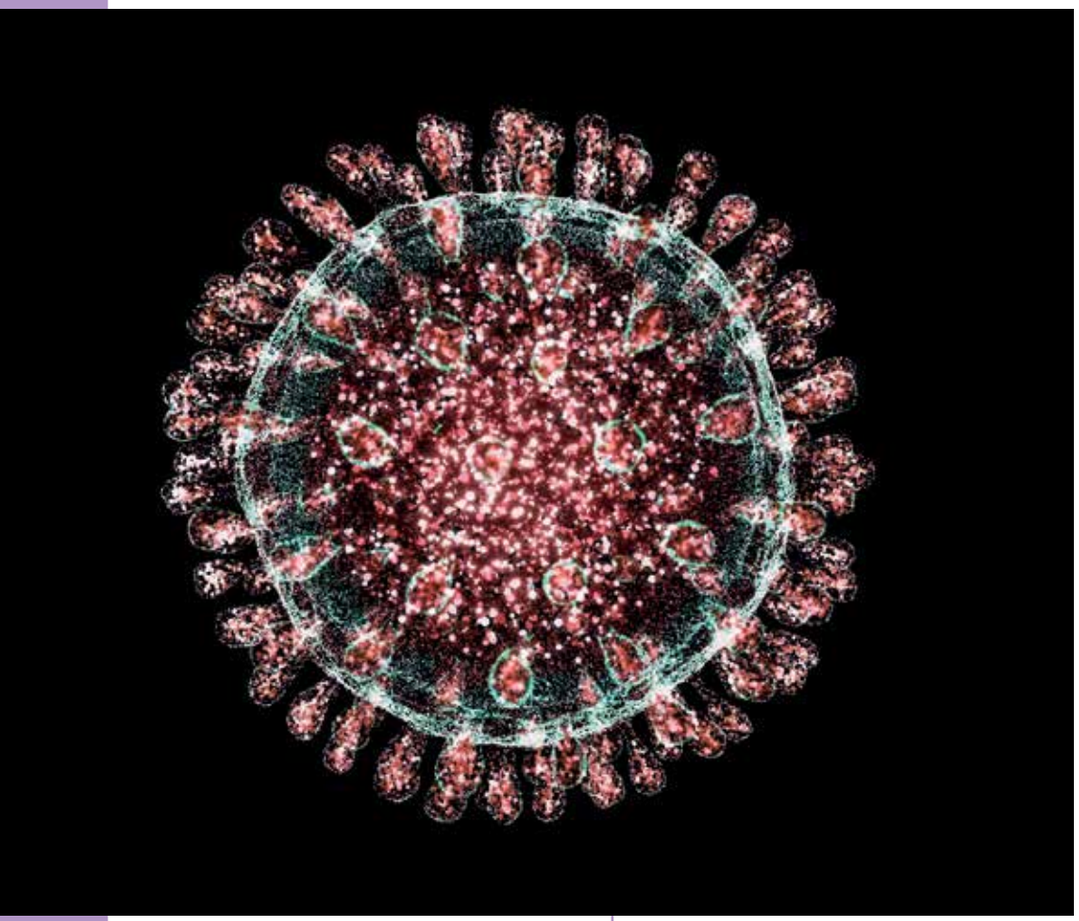
In Singapore, one in 150 children has autism, a developmental disorder affecting behaviour and communication. Due to a lack of understanding of its underlying cause and mechanism, there is currently no standard treatment for autism. Angelman Syndrome (AS) is a rarer form of autism spectrum disorder, but studying this disease will be helpful to find common molecular pathways disrupted in the autistic brain.

In a first-of-its-kind study led by Duke-NUS and National Neuroscience Institute, researchers have investigated and uncovered the underlying mechanism behind epileptic seizures caused by AS. Using human neural cells and brain organoids, the study showed that a specific ion channel in brain network hyperactivity is accountable for epileptic seizures. This is linked to the Ubiquitin Protein Ligase E3A (UBE3A) gene deficiency in neurons.

The disruption to the UBE3A gene is shared by AS and autism, leading researchers to believe that the discovery of this underlying mechanism can eventually lead to therapeutic options and treatment for autism, AS and other disorders with similar symptoms. The study's findings also highlighted the importance of utilising human cells in the modelling of human developmental disorders — a research milestone for future studies.

# 15

## Combating COVID-19



▲ The SARS-CoV-2 virus which causes COVID-19.

In late 2019, a novel coronavirus (COVID-19) originating in China began to spread around the globe. In January 2020, scientists from Duke-NUS, along with clinicians and scientists from SingHealth Duke-NUS Academic Medical Centre, Singapore General Hospital, National Centre for Infectious Diseases and Ministry of Health, successfully cultured the coronavirus from an infected patient's clinical sample, making Singapore the third country in the world to do so. Cultured within a week of Singapore's first case, the virus sample paved the way for more accurate diagnosis and the development of the first serological tests which helped to identify an important missing link between three major COVID-19 clusters in Singapore. Their research was featured in news headlines around the world, and received public commendations from Singapore Prime Minister Lee Hsien Loong and Deputy Prime Minister Heng Swee Keat.

In May 2020, Duke-NUS scientists invented a first-in-the-world SARS-CoV-2 serology test called cPass™, which can rapidly detect neutralising antibodies without the need for containment facilities or live biological materials. The test kit, co-developed by GenScript and A*STAR, was made available to Singapore hospitals and can be used to see if potential vaccines work, check what proportion of the population has already been infected, and for contact tracing applications.

In a bid to develop a novel vaccine for COVID-19, Duke-NUS also entered a partnership with Arcturus Therapeutics. Based on Arcturus Therapeutics' STARR Technology, which combines RNA with LUNAR® — a leading nanoparticle non-viral delivery system — to produce proteins inside the human body, the proposed vaccine utilises Duke-NUS' platform which allows for the rapid screening of vaccines for effectiveness and safety. The self-replicating RNA-based therapeutic vaccine develops immunity by triggering rapid and prolonged antigen expression within host cells.

# *Inspire, Aspire* — Our Outstanding Alumni

From clinician scientists to clinician educators, Duke-NUS graduates have gone on to achieve much in the medical field after graduation. Hailing from different backgrounds, Duke-NUS Clinicians Plus leverage their personal experiences as well as lessons learned at Duke-NUS well into their careers, motivating them to enhance the healthcare industry in their own unique ways. With a passion for medicine, research and the Clinician Plus spirit which spurs them on, Duke-NUS graduates are poised for greatness and success.

*p.47* **Dr Lim Kheng Choon**

*p.49* **Dr Rena Dharmawan**

*p.51* **Dr Tay Khwee Soon Vincent**

*p.53* **Dr Shan Koh Bundgaard**

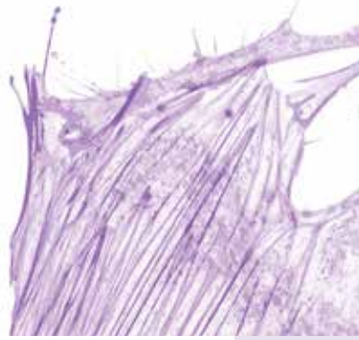
*p.55* **Dr Charmain Heah**

*p.57* **Dr Eugenia Ong**

*p.59* **Dr Hiu Yeung Lau**

*p.61* **Dr Ruan Xucong**

*p.63* **Dr Hwarng Yung-Hsin Gwen**

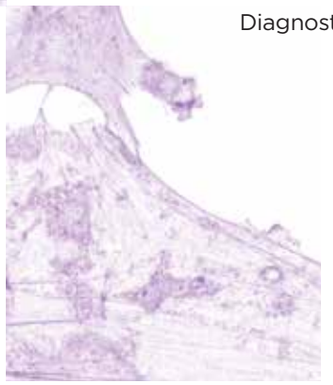


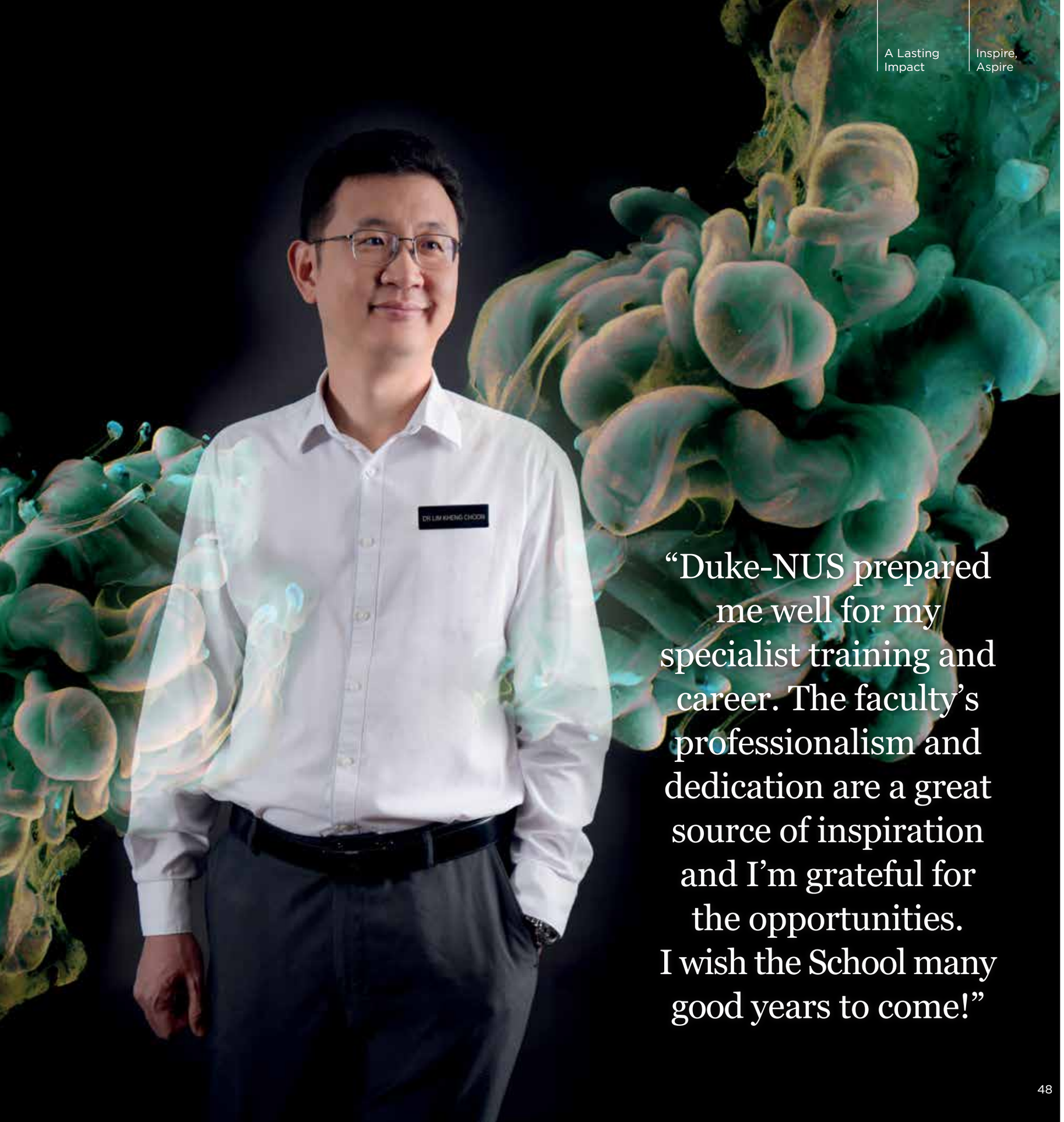
## Dr Lim Kheng Choon

*MD Class of 2011*

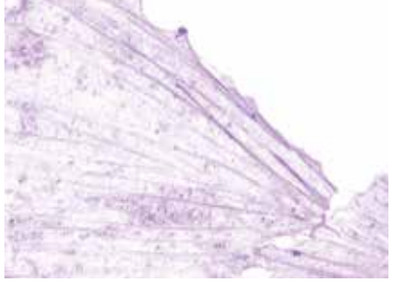
- Consultant, Department of Diagnostic Radiology, Singapore General Hospital
- Honorary Secretary, Singapore Medical Association
- Director, Singapore Medical Association Charity Fund

With a background in mechanical engineering, Kheng Choon spent seven years in the air force as an aircraft engineer. Inspired by how the medical team cared for victims of the 2004 tsunami and the dramatic impact they had on those they helped, he made a career switch, joining the pioneer batch of MD students at Duke-NUS and receiving his medical degree in 2011. A top student, Kheng Choon published a paper on liver cancer in the prestigious *Annals of Surgery*, and was conferred the SingHealth David Sabiston Gold Medal in Surgery — awarded to the most outstanding student in the field of surgery. During his specialist training with SingHealth Diagnostic Radiology Residency, he was appointed Chief Resident under the Singapore Chief Resident Programme and also won the SingHealth Publish! Award (Outstanding). He is now a Consultant with the Department of Diagnostic Radiology at Singapore General Hospital.






"Duke-NUS prepared me well for my specialist training and career. The faculty's professionalism and dedication are a great source of inspiration and I'm grateful for the opportunities. I wish the School many good years to come!"

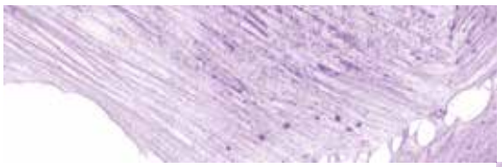


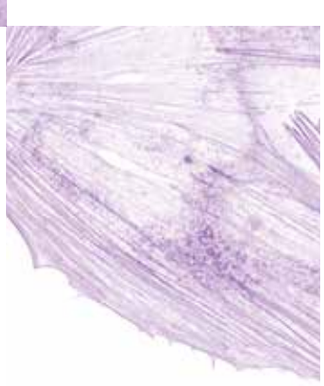
## Dr Rena Dharmawan

*MD Class of 2011*

- Associate Consultant, Head & Neck Surgery, Division of Surgery and Surgical Oncology, National Cancer Centre Singapore
- Entrepreneur-in-Residence, Centre for Technology and Development (CTeD), Duke-NUS Medical School
- Co-founder of Medtech Start-ups: CATALYST, Privi Medical and Jaga-Me
- Singapore-Stanford Biodesign Fellow 2014

Rena is fondly known as Duke-NUS' clinician innovator, with three start-ups under her belt — Privi Medical, an innovation-driven medical technology company that developed a US FDA-approved disposable medical device which alleviates haemorrhoid-related bleeding and pain; Jaga-Me, an online platform that matches home-nursing care to families in need of services; and CATALYST, a co-working space targeting medtech and healthtech start-ups in Singapore. She earned a biomedical engineering degree before she enrolled at Duke-NUS Medical School, bringing her prior experiences along with her. She is currently also an Entrepreneur-in-Residence at CTeD, and works to ensure optimal commercial outcomes for all Duke-NUS inventions.



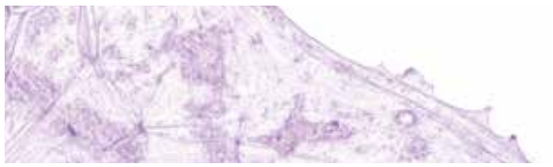



"Duke NUS' unique curriculum doesn't just emphasise clinical knowledge, but also research. This has prepared and given me the opportunity to pursue my passion in both surgery and medical device innovation."

## Dr Tay Khwee Soon Vincent

*MD Class of 2011*

- Associate Consultant, Plastic Surgery Service, Department of Surgery, Changi General Hospital
- Adjunct Research Fellow, Academic Medical Research Institute (AMRI), Duke-NUS Medical School
- Clinical Lecturer, Yong Loo Lin School of Medicine
- Winner of National Outstanding Clinician Scientist Resident Awards 2017



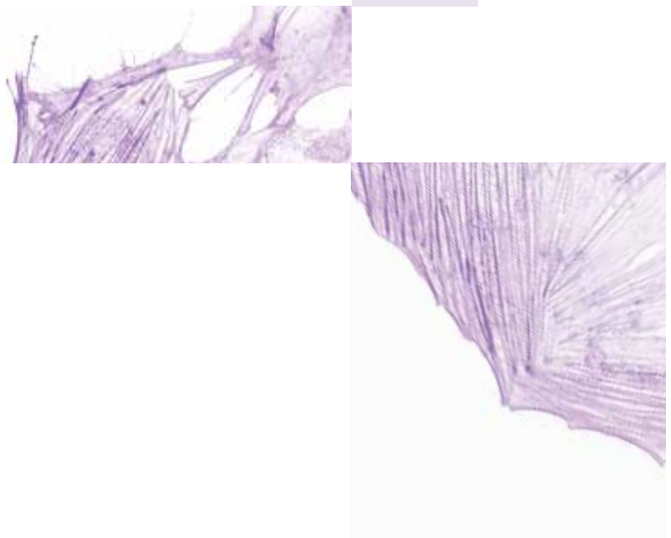
Prior to Duke-NUS, Vincent studied Pharmaceutical Science at NUS, on a scholarship from the Defence Science and Technology Agency before serving at the Defence Medical Environmental Research Institute. Enrolling into the pioneer Class of 2011, he also served as vice-president on the Students' Executive Committee. His research in translating the use of adipose derived cells in plastic surgery received almost half a million dollars in grant funding from the National Medical Research Council (NMRC) Clinician Scientist New Investigator Grant — awarded to a resident for the first time — and Khoo Mentored Research Award. He was also the inaugural recipient of the National Outstanding Clinician Scientist Resident Award in 2017. In 2019, Vincent pursued a fellowship in Plastic and Aesthetic Surgery at Akademikliniken, Sweden. Returning in January 2020, he joined the Plastic Surgery Service at Changi General Hospital.


"As the pioneer batch from Duke-NUS, we faced many challenges and an uncharted landscape from day one. But in crisis, you find opportunities. We carved out our own paths and wrote our own rules."

## Dr Shan Koh Bundgaard

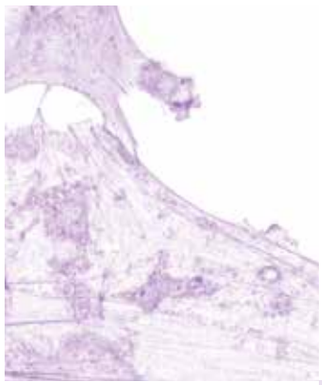
*MD Class of 2011*

- Assistant Professor
  Student Academic Support,
  Duke-NUS Medical School



Shan received her Bachelor of Arts in Biology from Pomona College in California, and worked as a Research Assistant at the Center for Clinical Sciences Research at Stanford University Medical Center prior to her enrolment at Duke-NUS. After her residency at KK Women's and Children's Hospital, she joined Duke-NUS as a clinical instructor in 2015 to nurture future generations of clinicians. Between 2015 and 2017, she co-managed the Duke-NUS Clinical Overlay (CLOVER) Programme — a novel proactive initiative for coaching medical students struggling with academic and/or clinical skills development. She subsequently transitioned to full management in July 2017, leading the development and running of the Student Academic Support Programme. Her work is aimed at helping students with their academic planning, teaching them to identify and use more effective learning strategies, exam-focused skills, providing targeted and even individualised academic support and advice to enable students to succeed in their learning journey. Shan has also been an integral part of developing the Clinical Reasoning thread that runs through all four years of the MD Programme.

"Duke-NUS pushed me to exceed my expectations. I returned to teach because I know what the journey is like, and to help my juniors in their journey."

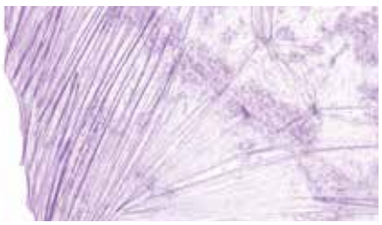


All her life, Charmain had always known she wanted to be a doctor. Despite initially pursuing an education and career in science and research — graduating with a BSc (Hons) in Molecular and Cell Biology from University of York, and taking on the role of Research Assistant at the Sir William Dunn School of Pathology — Charmain found herself unable to ignore the clarion call of medicine, and eventually enrolled at Duke-NUS. Drawn to the dynamic and galvanising challenges of Emergency Medicine after a soul-stirring experience in the resuscitation room as a student, Charmain naturally carved out her medical career in Emergency Medicine. Grateful to her alma mater for the chance to study medicine, Charmain gladly took the opportunity to become a college master at Duke-NUS, in order to give back to the School's community.

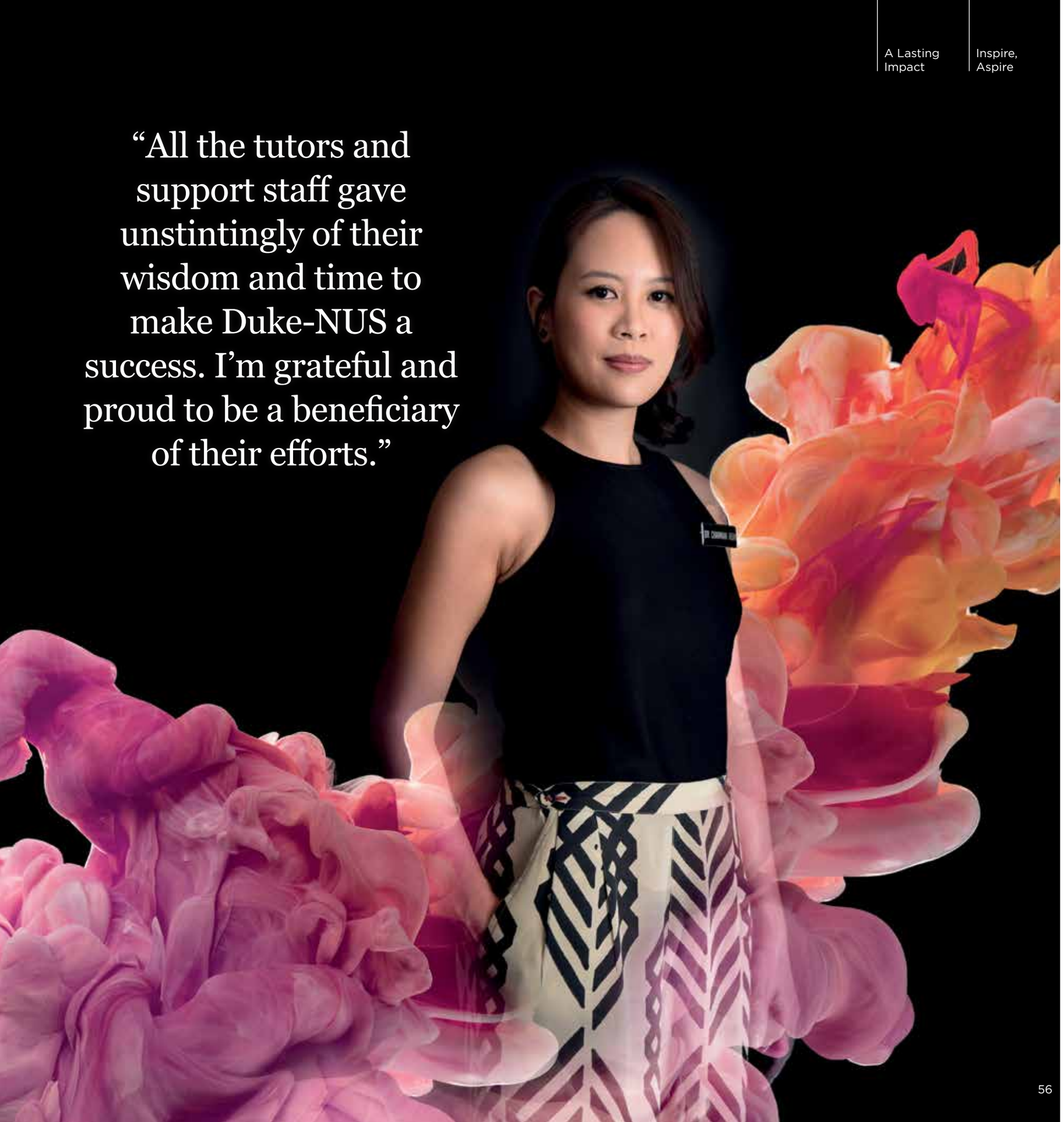
**Dr Charmain Heah**

*MD Class of 2013*

- Associate Consultant, Department of Emergency Medicine, Tan Tock Seng Hospital
- College Master, Eugene Stead College, Duke-NUS



"All the tutors and support staff gave unstintingly of their wisdom and time to make Duke-NUS a success. I'm grateful and proud to be a beneficiary of their efforts."

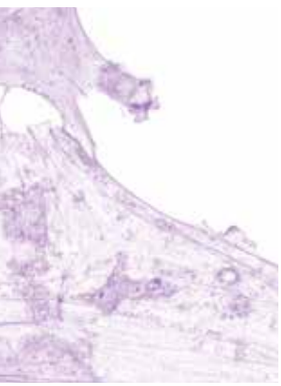


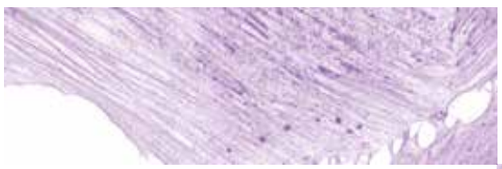
## Dr Eugenia Ong

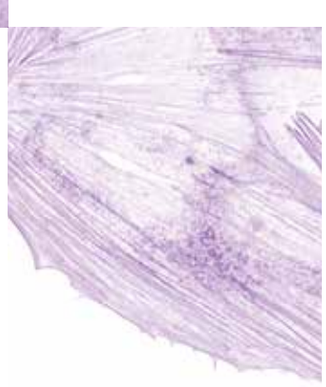
*PhD Class of 2015*

- Senior Research Fellow, Emerging Infectious Diseases Programme, Duke-NUS Medical School
- Senior Research Fellow, Viral Research and Experimental Medicine Centre @ SingHealth Duke-NUS (ViREMiCS)
- Duke-NUS Medical School EID Excellence in Research Staff Award 2019
- Duke-NUS Achievement Award 2015 for most outstanding Duke-NUS PhD/MD-PhD student

Graduating with a First Class Honours in Biological Sciences from Nanyang Technological University, Singapore, Eugenia was awarded the A*STAR Graduate Scholarship, to embark as a member of the inaugural cohort, on the PhD in Integrated Biology and Medicine programme at Duke-NUS in 2010. After graduating in 2015, Eugenia joined the Experimental Therapeutics Centre at A*STAR, where she worked on pre-clinical studies for an anti-dengue therapeutic antibody. She then joined the Viral Research and Experimental Medicine Centre @ SingHealth Duke-NUS (ViREMiCS) and Duke-NUS as a research fellow in 2017, and manages laboratory assays that drive pre-clinical and clinical development for anti-infective therapeutics and vaccines. To value-add to her work and gain insights on drug regulation trends, Eugenia is also participating in CoRE's Graduate Certificate in Pharmaceutical Regulation programme. Eugenia's contributions to her field clinched her the Duke-NUS Achievement Award 2015 for most outstanding Duke-NUS PhD/MD-PhD student and the Duke-NUS Medical School EID Excellence in Research Staff Award 2019. In 2020, she was also one of the inspiring young achievers who won a spot in the Prestige 40 Under 40 list.







"I am grateful to my mentors, Prof Ooi Eng Eong and A/Prof Jenny Low, who have allowed me the opportunity to traverse the interface of science and medicine. That set me on the trajectory to pursue a career in translational medicine."

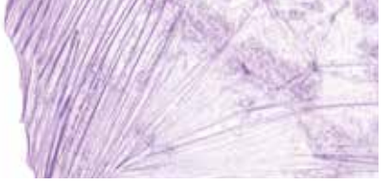
Hiu Yeung graduated from Johns Hopkins University with a Bachelor of Science in Molecular and Cell Biology. He then began his career as a research officer in A*STAR, with an interest in biomedical research. After a year, he decided that following the path of medicine would open new perspectives and opportunities, and enrolled at Duke-NUS for the MD-PhD programme in 2010. During his time at Duke-NUS, Hiu Yeung conducted research on identifying novel means of inhibiting the RAS pathway in the context of cancer biology, and authored two research papers as well as one review paper. He is currently in the midst of preparing another research manuscript on the subject. After graduating, Hiu Yeung started residency training with SingHealth Pathology.

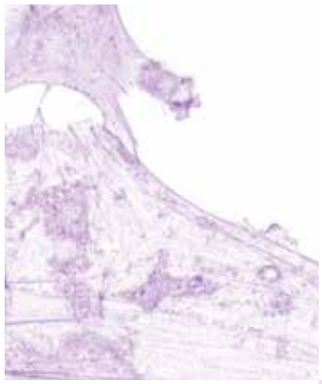
**Dr Hiu Yeung Lau**

*MD-PhD Class of 2018*

- Resident, Pathology, SingHealth
- Recipient of Duke-NUS 10th Anniversary Scholarship and Shaw Foundation Scholarship
- Recipient of SingHealth Medical Student Talent Development Award 2017

"My medical education and research experience in Duke-NUS has given me the knowledge, skills and opportunities for me to aim towards a career of collaboration, putting together medical diagnostics and research, to make a difference in patients' lives."



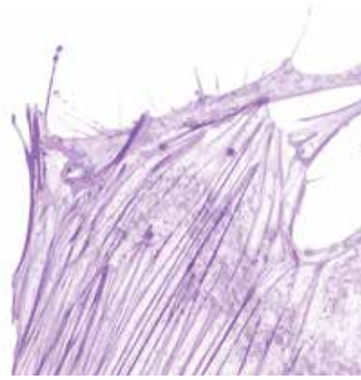


## Dr Ruan Xucong

*MD Class of 2017*

- Senior Resident, Cardiology, SingHealth
- 2019 SingHealth RiSE Award — Inspiring Resident-Educator Award
- Duke-NUS Medical Alumni Committee member
- One of the main drivers for SingHealth's Project INSPIRE
- Ambassador for Class of 2017

Armed with a degree in Pharmacy from NUS, Xucong enjoyed communicating with patients, which led her to pursue a career in medicine at Duke-NUS. After overcoming her own apprehension of becoming a House Officer, she decided to help her juniors make the transition easier. Drawing inspiration from her own experiences, she offered mentorship and guidance to graduating students upon becoming an alumnus. Today, she is one of the main drivers of Project INSPIRE, a SingHealth Internal Medicine programme that prepares graduating medical students for the graduating exam and House-Officership. For her contributions, she received the SingHealth RISE Award — Inspiring Resident-Educator Award.

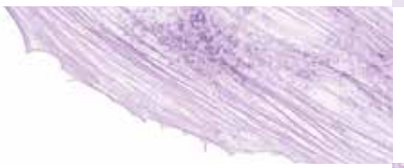


"I had great support from our faculty and seniors who helped me transition from a medical student to a doctor. Likewise, I want to help future students transition effectively through near-peer teaching and mentoring programmes."

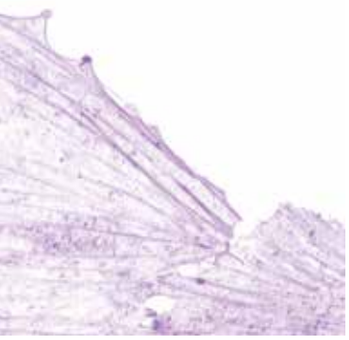
## Dr Hwarng Yung-Hsin Gwen

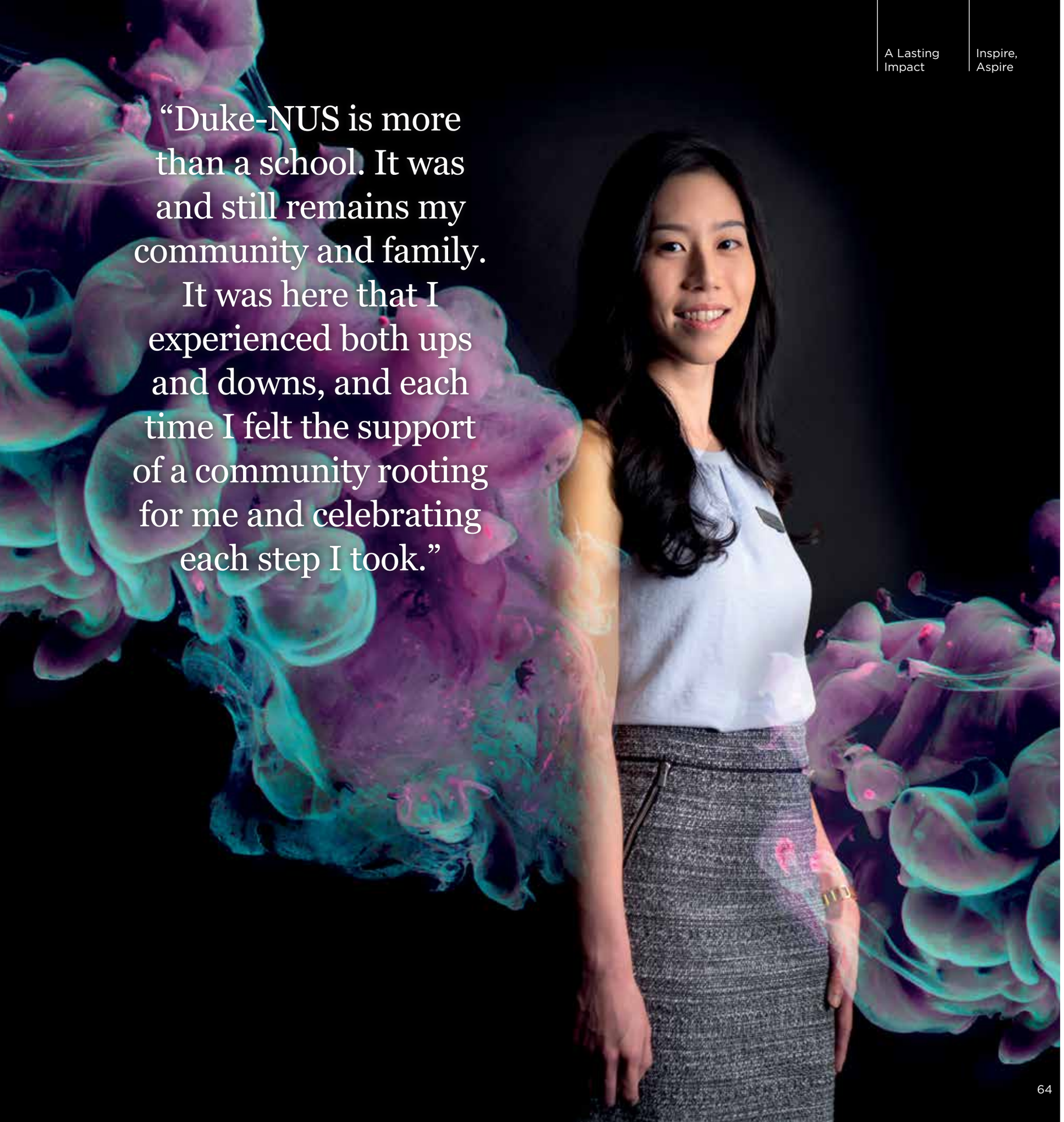
*MD Class of 2018*

- Resident, Family Medicine, SingHealth
- SingHealth Best House Officer Award 2019
- Duke-NUS Medical Alumni Committee member
- Ambassador for Class of 2018



While undertaking her Bachelor of Science from the University of North Carolina, Gwen collaborated with Kenyan medical authorities to develop the adoption process for abandoned Kenyan babies, under the Amani Children's Foundation. Motivated by the physicians caring for these babies, she felt her public health major would aid in her pursuit of becoming a doctor. At Duke-NUS, Gwen was a key advocate in community service projects such as Camp Simba, World Autism Awareness Week and Star PALS (Paediatric Advanced Life Support). She was also actively involved in research, presenting her project "Accuracy of Parent-Reported Ages and Stages Questionnaire in Assessing the Developmental Outcome of Preterm Infants" at the 13th Congress of Asian Society for Paediatric Research in Hong Kong and the 6th Singapore Paediatric and Perinatal Annual Congress (SiPPAC). As the valedictorian of her graduating class, Gwen's outstanding performance during her House Officer year won her the SingHealth Best House Officer Award in 2019.

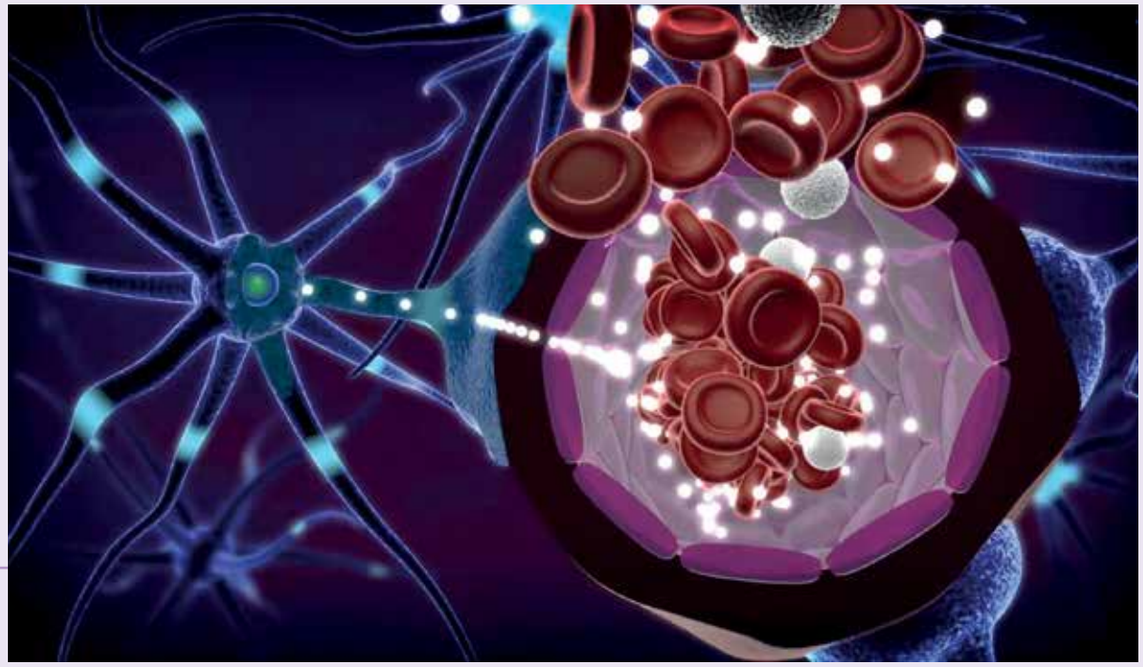




"Duke-NUS is more than a school. It was and still remains my community and family. It was here that I experienced both ups and downs, and each time I felt the support of a community rooting for me and celebrating each step I took."

# *Commercialisation With A Purpose*
## — Impact Of CTeD Start-Ups

The Centre for Technology and Development (CTeD) facilitates the commercial application of research results at Duke-NUS. While managing and overseeing intellectual property of Duke-NUS, CTeD's goal is to ensure optimal commercial outcomes for all Duke-NUS inventions. Partnerships in both the public and private sector aid the Centre in adding value to Singapore's biomedical research ecosystem.



▶ An illustration of the blood brain barrier.

### Penetrating the Blood-Brain Barrier

**Travecta Therapeutics Pte Ltd**

The protective blood-brain barrier of the central nervous system is highly effective at preventing toxic compounds from entering the brain. As a result, more than 98 per cent of drug molecules are also unable to enter the brain, making it difficult to treat diseases of the brain, eye and central nervous system.

Travecta Therapeutics Pte Ltd was co-founded by Professor David Silver, from Duke NUS' Programme in Cardiovascular & Metabolic Disorders, based on his team's discovery that a transporter protein called Mfsd2a carries lipids, such as docosahexaenoic acid (DHA), in the chemical form of lysophosphatidylcholine (LPC) to the brain.

Building on a deep understanding of the Mfsd2a transporter, Travecta's proprietary platform, mVECTA™ allows the targeting of key biological targets across the blood-brain barrier, aiding in the development of new therapies for currently untreatable diseases, and potentially revolutionising treatments for neurological conditions.

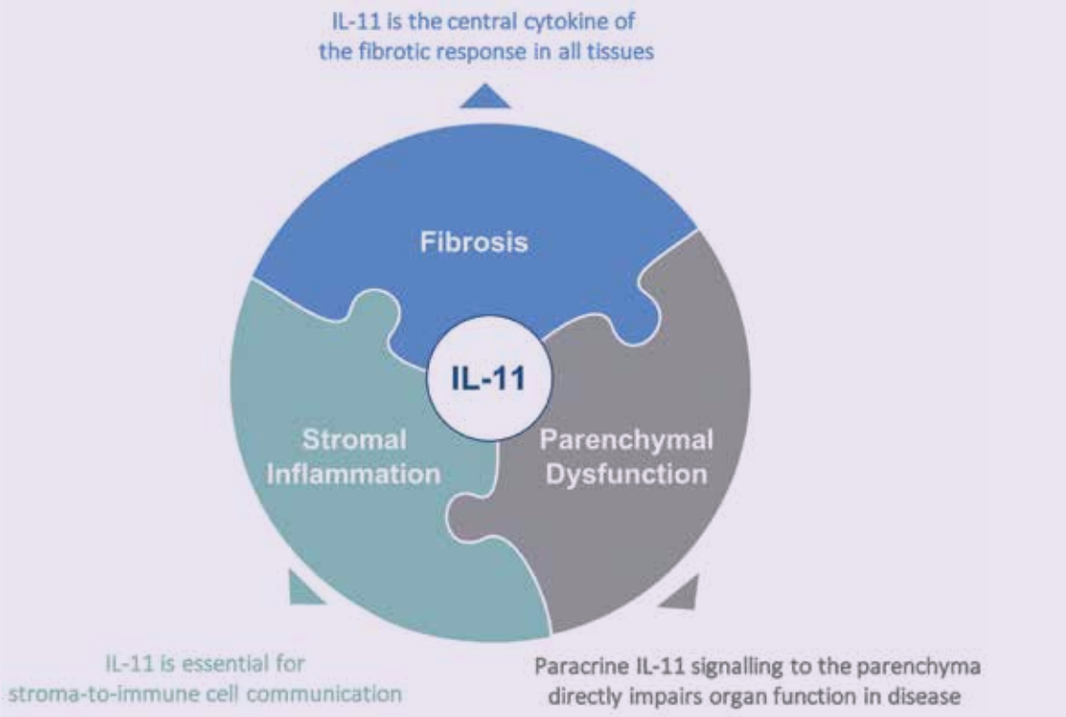
Travecta has secured US$15 million in Series A funding for the mVECTA™ platform from TKS1, a life-sciences-focused venture capital fund stemming from a partnership between SPRIM Ventures and Tikehau Capital. This will be used to develop TVT-004 — Travecta's leading non-opioid product, which targets pain — with clinical trials potentially beginning in 2021, as well as the progression of earlier stage research programmes in neuro-oncology and neuro-inflammation.

## Therapeutics for Fibrotic Diseases

**Enleofen Bio Pte Ltd**

Interleukin-11 (IL-11) belongs to a class of proteins, known as cytokines, that mediates fibrosis. A breakthrough discovery in cardiovascular fibrosis by Professor Stuart Cook and Assistant Professor Sebastian Schafer from Duke-NUS' Programme in Cardiovascular and Metabolic Disorders and National Heart Centre Singapore, showed that blocking IL-11 can inhibit fibrotic diseases of the heart, liver and lungs. With few treatment options available for fibrotic diseases — a major cause of illness and death around the world — the compelling need led to their founding of Enleofen Bio Pte Ltd to develop first-class therapeutics for the treatment of such diseases, including nonalcoholic steatohepatitis (NASH) and Interstitial Lung Diseases (ILDs) like idiopathic pulmonary fibrosis.

In December 2019, the privately-owned German drug company Boehringer Ingelheim International entered into a deal with Enleofen Bio to purchase the company's assets and take over the licensing of the intellectual property assets from the owners, Duke-NUS and SingHealth, with a view to developing preclinical drug candidates that target IL-11. Enleofen's lead product candidate, ENx108A, is an IL-11-targeting antibody that has been shown to reverse organ dysfunction by targeting fibrosis and inflammation. Other product candidates include ENx203 and ENx209, as well as second-generation therapeutics. Boehringer Ingelheim's initial focus will be on developing novel therapies for patients with NASH and ILDs, two of their core disease focus areas, with potential for further expansion into other fibro-inflammatory conditions based on IL-11's central role in disease. The company will work closely with Duke-NUS to further develop the anti-IL-11 antibody platform and translate it into clinical development, with the prospect of addressing the currently unmet needs of patients around the world.

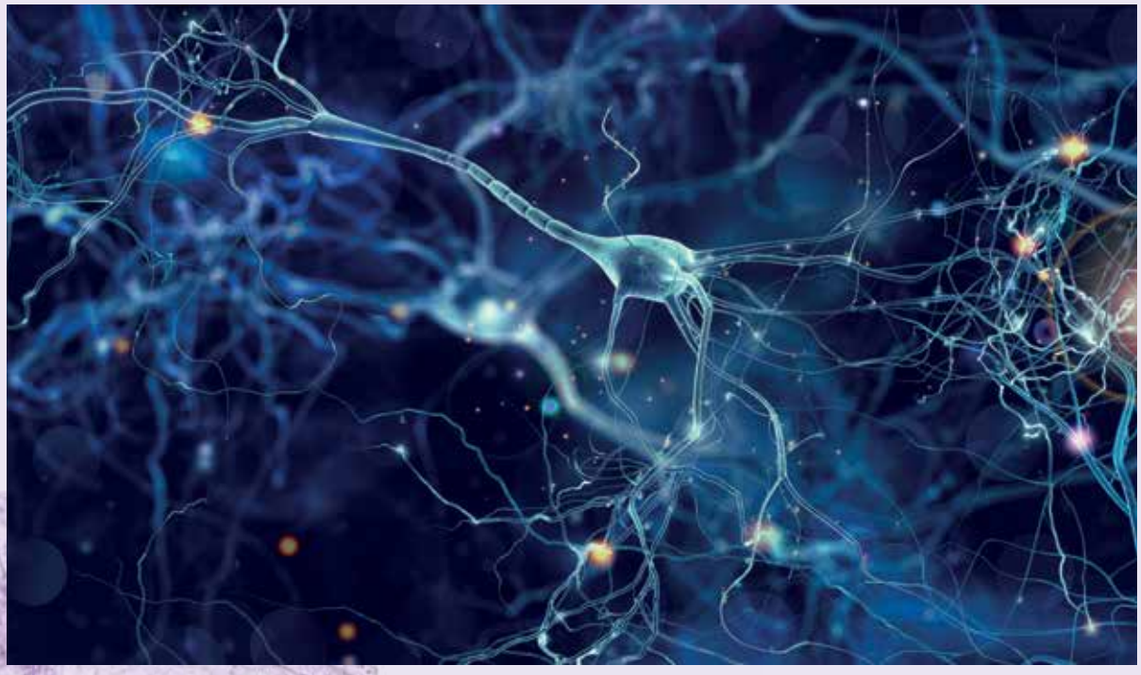



▲ The team behind Enleofen Bio Pte Ltd.

## cPASS: the SARS-CoV-2 serology test that detects neutralising antibodies

In partnership with GenScript Biotech Corporation and A*STAR's Diagnostics Development Hub (DxD Hub), Duke-NUS is leading the co-development and manufacturing of a unique serological COVID-19 detection system, marketed as cPass™. This test, developed by Professor Wang Linfa and his team from Duke-NUS' Programme in Emerging Infectious Diseases, enables rapid detection of neutralising antibodies without the need for live biological materials and biocontainment facilities, meaning it can be deployed in a standard hospital laboratory.


▲ The cPASS™ test kit. *Photo credit: GenScript Biotech Corporation.*



▲ Illustration of neuron cells.

The partnership with A*STAR's DxD Hub has since facilitated regulatory approvals from Singapore's Health Sciences Authority, which enabled the distribution of the cPass™ test kit to hospitals around the country, while GenScript has led applications for regulatory approval in the EU, US and other markets around the world.

The cPass™ test is expected to have a major impact on COVID-19 investigations, such as contact tracing, reservoir or intermediate animal tracking, assessment of herd immunity, longevity of protective immunity and efficacy of different vaccine candidates.

## Enhancing Treatment Options for Neuropsychiatric Diseases

**Evecxia Inc**

There is an inadequacy in the current range of therapies for patients suffering from common, disabling and costly neuropsychiatric conditions, such as depression. Based in the Research Triangle Park in North Carolina, USA, Evecxia Inc. is a biopharmaceutical company seeking to develop solutions for treatment-resistant depression and other neuropsychiatric and non-psychiatric disorders. Its first lead compound is EVX-101, a treatment targeted at patients who are not achieving an adequate response to traditional antidepressants.

Dr Jacob Jacobsen, one of Evecxia's founders and its Chief Scientific Officer and a past faculty member at Duke-NUS, worked with colleagues at the National University Hospital and NTUitive to generate the key intellectual property (IP) that enabled the development of EVX-101, a new formulation of 5-hydroxytryptophan (5-HTP). In 2018, the company was granted the rights to develop and commercialise this jointly-owned IP.

With the licensing rights, Evecxia aims to develop a treatment using slow-release formulations of 5-HTP and low-dose carbidopa for treatment-resistant depression. In 2019, Evecxia announced it had successfully raised almost US$2 million for further development of EVX-101, and the formulation of other technologies and treatments for neuropsychiatric diseases.

◀ Conducting research in the laboratory.

## Harnessing Big Data-Science for Cell Therapy

**Mogrify Ltd**

Assistant Professor Owen Rackham, from Duke-NUS' Programme in Cardiovascular and Metabolic Disorders, co-founded Mogrify Ltd with his academic colleagues at the University of Bristol in the UK, Monash University in Australia, and RIKEN, a major scientific research institute in Japan. Mogrify Ltd uses a network-based algorithm to identify optimal combinations of transcription factors that influence cellular change. This systemic, big data-science approach can be applied to various medical research applications and potentially transform the face of cell therapy.

By 2019, Mogrify had secured US$20 million in funding towards research and licensing of their direct conversion approach to cell therapy. Expansion of a new base in Cambridge, UK, is also underway.

Through the funding, the company will continue to enhance its big data-science approach, and develop innovative technologies to address the efficacy, safety and scalability issues currently associated with cell therapy development and manufacturing.

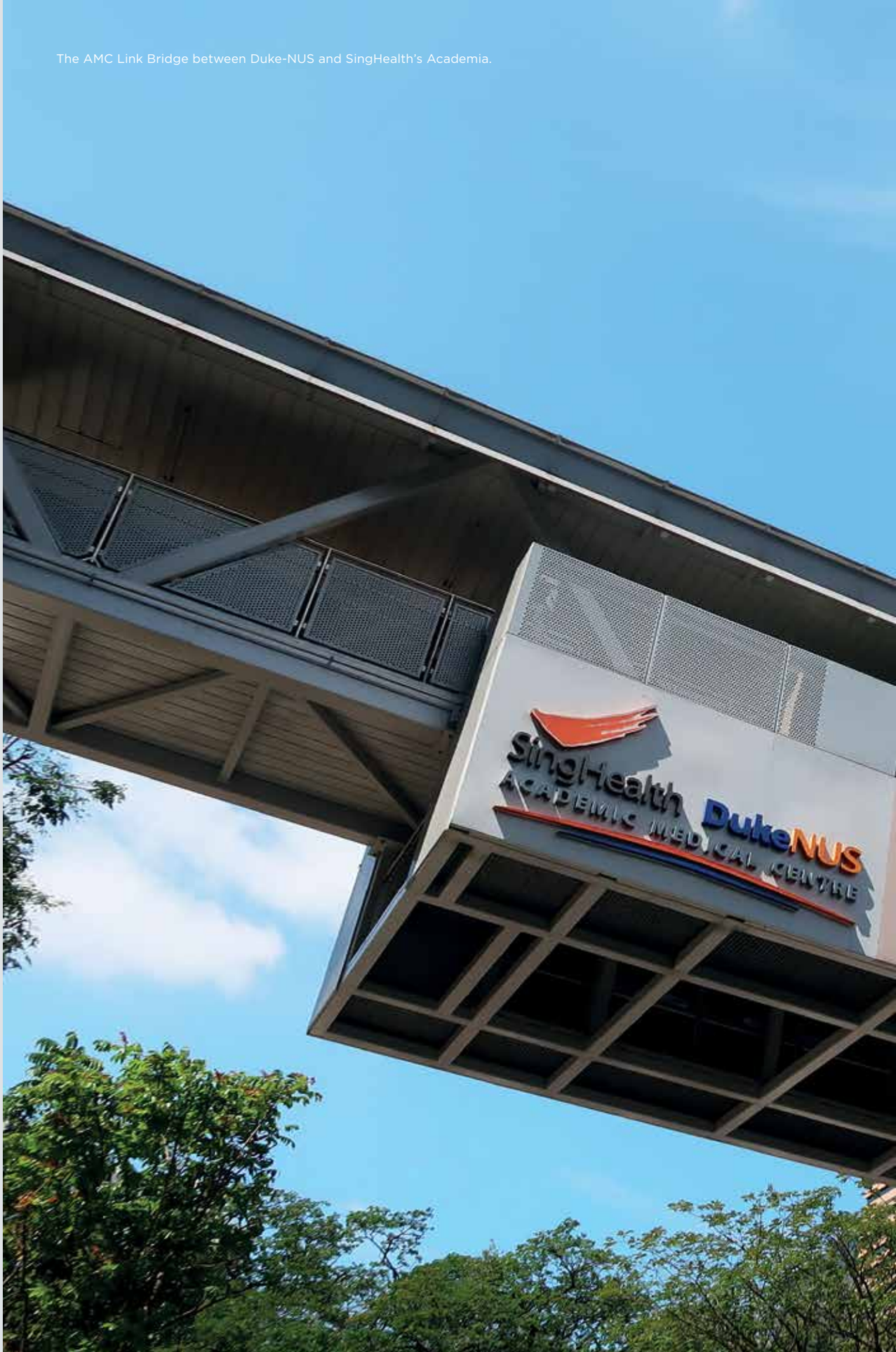
Apart from partnerships with disruptive innovators in the regenerative medicine, cell therapy, bio-manufacturing and research sectors, Mogrify's work won the company the prestigious Scrip award for innovation, in recognition of the immense potential such a technology has to disrupt future development of new medicines.

▲ The Mogrify Ltd team at their new base in Cambridge.

# *Looking Forward*

*"We continue to strengthen our partnership with SingHealth and collaborate with key institutions in Singapore and beyond, to nurture and develop outstanding Clinicians Plus. We are filled with excitement to continue transforming medicine and improving lives."*

**Professor Thomas M Coffman**
*Dean*
*Duke-NUS Medical School*



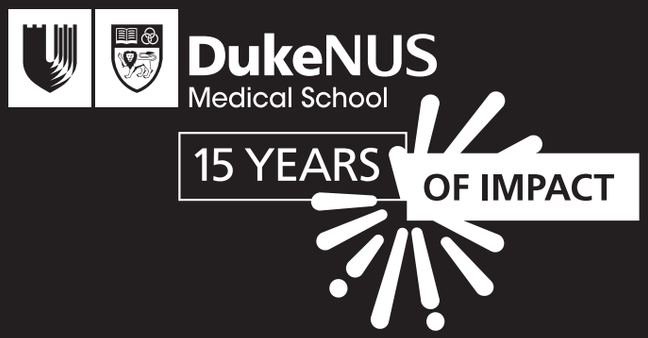

The AMC Link Bridge between Duke-NUS and SingHealth's Academia.


Defining Tomorrow's Medicine
4.5m

*The Duke-NUS 15th anniversary commemorative book would not have been possible without your help. We would like to extend our gratitude to all of you for making this a memorable record of our collective achievements. Thank you, and we hope you will enjoy reading this.*

**Communications and Strategic Relations team**

DukeNUS




Duke
UNIVERSITY

NUS
National University
of Singapore

SingHealth DukeNUS
ACADEMIC MEDICAL CENTRE