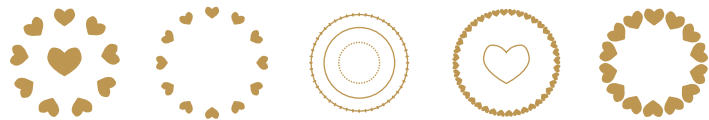


20

JOURNEYING AS ONE HEART.
TWO DECADES OF MEMORIES.

Journeying as One Heart.

Two Decades of Memories.



Message from Professor Terrance Chua

Twenty years ago, the National Heart Centre Singapore was established to provide excellent cardiovascular care to the nation. Initially housed in a modest refurbished 4-storey Mistri Wing building that was previously a paediatric ward, we have steadily grown in strength to be a centre of academic medicine - pioneering the adoption of new diagnostic and treatment options, teaching generations of students and specialists, and developing a reputation for groundbreaking research.

Today, occupying a 12-storey building, NHCS remains to be a regional centre for cardiovascular care, innovation and education. It continues to be one of the region's busiest cardiovascular speciality centre – with over 1.9 million patient visits over the last 20 years.

None of this would be possible without the determined and sustained efforts of the people who built the NHCS reputation into what it is today and continue to keep its mission and vision alive. This book pays tribute to their efforts and documents the key milestones that were achieved through determination and planning.

Many of Singapore's efforts to bring advances in cardiac care to our people were first introduced at this campus. NHCS performed Singapore's first Heart Transplant in 1990, Singapore's first Automatic Implantable Cardioverter Defibrillator (AICD) implantation in 1992, and Southeast Asia's first Left Ventricular Assist Device (LVAD) implantation in 2001.

As the nation's population ages, health needs become increasingly complex, for example, heart disease is not only an increasing risk to the elderly, but also to the younger age. It is therefore imperative that we continue to seek advances in medicine, and provide not just good healthcare, but value-based healthcare to our patients.

The launch of our cardiology services in Sengkang General Hospital aims to provide accessible, comprehensive and patient-centred care to the community in the North East region. Located close to the community, we are able to work closely with various community healthcare partners and providers to better care of our patients.



As the regional leader in cardiovascular health, NHCS is reputed to be a centre for education and training in cardiac care. Over the past 20 years, NHCS attracted more than 200 heart specialists from across 16 countries for subspecialty training fellowship attachment. In 2018, we facilitated the training for about 350 medical students; providing them in-depth and experiential learning into the medical world. In addition, we organised about 24 international conferences and workshops annually, hosting global experts in cardiovascular intervention and cardiothoracic surgery. Our annual signature conference - Singapore LIVE, is one of the reputable live courses in cardiac interventions in the Asia Pacific region. It brings key expertise and experiential exposure through live demonstrations and cross-sharing across 30 countries in the region. The event in 2019 drew more than 1,000 participants.

The move to the new NHCS building in 2014 was a significant milestone and a vital transition to meet the rapidly growing demand for cardiac care. The development provided an opportunity for us to build in six operating theatres and three cardiac catheterisation laboratories, and pioneered initiatives such as the 1-Queue-1-Bill system. More importantly, we integrated the capacity for research that laid the foundation for the National Heart Research Institute Singapore (NHRIS). NHRIS, a collaboration with Duke-NUS Medical School's Signature Cardiovascular Metabolic Programme which was officially launched by the then President Tony Tan in 2014.

The work of the NHRIS has led to several breakthrough discoveries. The major discovery of Interleukin-11 (IL11), a critical protein, to be the cause of scarring and heart and kidney failure, allows us to translate this knowledge to clinical application and gives us the opportunity to develop new treatments for heart and kidney failure.

As an institution, we are uniquely positioned to make great inroads into the sphere of cardiovascular medicine. We stand on the precipice of change, where science, technology and social advancement converge. The landscape of healthcare is evolving and there will be constant and rapid changes in the provision of healthcare and health management. We must embrace these advances and changes with a spirit of courage, so as to seize the opportunities presented, just as our pioneers have done in their time.

All of this would not be possible without the vision and dedication of our pioneers who supported and built the NHCS. To name but a few of our many pioneers including Dr Kwa Soon Bee, Prof Arthur Tan, Dr BA Johan, Dr Tan Ngoh Chuan, Prof Lim Yean Leng and Prof Koh Tian Hai, for their leadership and mentorship and dedication; without whom NHCS would not be what it is today.

This excellent effort is a fitting tribute to all the pioneers and NHCS team who have helped our institution serve our patients over the past two decades.

Professor Terrance Chua
Medical Director, NHCS

Message from Professor Ivy Ng

My heartiest congratulations to National Heart Centre Singapore (NHCS) and staff on the celebration of its 20th anniversary.

When NHCS was first founded two decades ago, it was located in a refurbished building at Mistri Wing with limited space and resources. It has since seen profound changes and has grown to become not only the nation's premier institution for the care of cardiovascular disease, but a renowned centre in the region for its advances in clinical care, education and research. It is also the only healthcare facility to host the national heart transplant programme which gifted more than 70 recipients with a new lease of life since its establishment in 1990.

NHCS has come a long way in the treatment of heart diseases – it is the pioneer in the adoption of many advanced diagnostic and therapeutic technologies such as structural heart interventions, atrial fibrillation ablation, left ventricular assist devices and complex coronary interventions.

In education, NHCS has built a good reputation and demonstrated great commitment to building capabilities for medical, nursing and allied health professions. Its continuous training and education efforts extend beyond local collaborations such as the formal training of Cardiac Technologists with Singapore Polytechnic to renowned international conferences like Singapore LIVE Course for coronary interventions.

Through the years, NHCS maintains a commitment to research across disciplines and constantly seek opportunities to improve patient care and outcomes. Some of the key research successes include the identification of a key pathway causing fibrosis in cardiac and other tissues and the development of a nation database for cardiac care outcomes (SingCLOUD). The launch of National Heart Research Institute Singapore in 2014 and development of the Cardiovascular and Metabolic Disorders Signature Research Programme by NHCS and the Duke-NUS Graduate Medical School, further affirmed NHCS' commitment to bringing good outcomes with cardiovascular research.



I commend NHCS for the excellent work through the 20 years' journey. This year marks an important milestone in their pursuit of excellence in clinical care, education and research. All these were made possible because of all of you in NHCS, who truly put patients at the heart of all you do.

I am confident that the leadership team and committed staff in NHCS will continue the good work, bringing NHCS to greater heights and excellence in cardiovascular care.

Professor Ivy Ng
Group Chief Executive Officer,
SingHealth

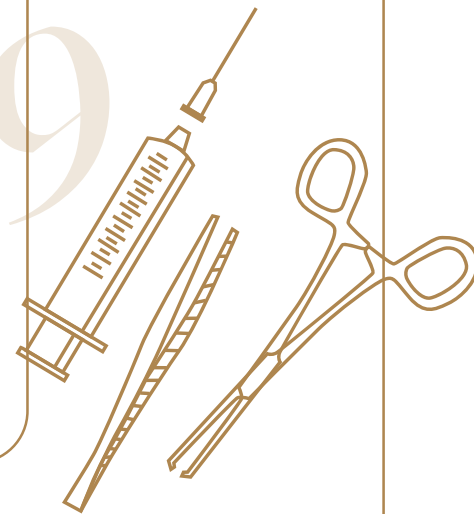
The background is a solid gold color. It is decorated with various white geometric shapes: a cluster of small dots in the top left; a large circle with a dashed outline in the top left; a solid circle in the top center; a circle with a dotted outline in the middle left; a large circle with a thick, multi-lined border in the middle left; a large circle with a dotted outline in the center; a circle with a ring of small circles around its perimeter in the middle right; a circle with a thick, multi-lined border in the bottom right; a circle with a dashed outline in the bottom center; a circle with a ring of small hearts around its perimeter in the bottom right; a heart shape inside a circle with a ring of small hearts around its perimeter in the bottom left; and a small circle with a thick, multi-lined border in the bottom center.

Key milestones
in pursuit of excellence
in patient care, research
and education



1999

- First biventricular pacing (for symptomatic relief in patients with moderate to severe heart failure on maximum medical therapy) procedure in Singapore
- National Heart Centre Singapore (NHCS) became autonomous



2000

- First Diploma in Biomedical Sciences (Cardiac Technology) in Singapore and Asia jointly offered with Singapore Polytechnic
- First lung transplant in Singapore performed jointly with Singapore General Hospital (SGH) and National Cancer Centre Singapore (NCCS)



2001

- First Mechanical Heart Device Programme in Singapore established
- First Left Ventricular Assist Device implantation in Singapore and Southeast Asia (pictured above)

2002

- First left ventricular reconstructive surgery performed
- First heart failure programme established in Singapore
- First percutaneous lead extraction in Singapore using the electrosurgical dissection sheath system
- First left ventricular assist device explantation in Singapore and Southeast Asia
- First biventricular assist device implantation in Singapore and Southeast Asia



2003



- First Specialist Diploma in Cardiac Technology with Singapore Polytechnic in Singapore and Asia
- Adult Congenital Heart Disease Programme (ACHD) established (pictured left)
- First bipolar radiofrequency ablation in Asia

2004

- First local inter-hospital transfer of patient on Extra-Corporeal Membrane Oxygenator (ECMO)



2005

- First heart hospital outside USA and in Asia to be accredited by the Joint Commission International (JCI) (pictured below)
- First robotic-assisted excision of mediastinal tumour on an 18-year-old male patient using da Vinci surgical system



2006

- First pulmonary vein isolation/Maze procedure using the EPICOR Cardiac Ablation system in Singapore and Asia
- Robotic Assisted Minimally Invasive Cardiothoracic Surgery (RAMICS) Programme established

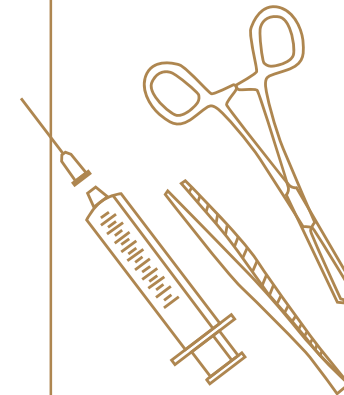
- First Homograft Bank established in Singapore (pictured right)



2008

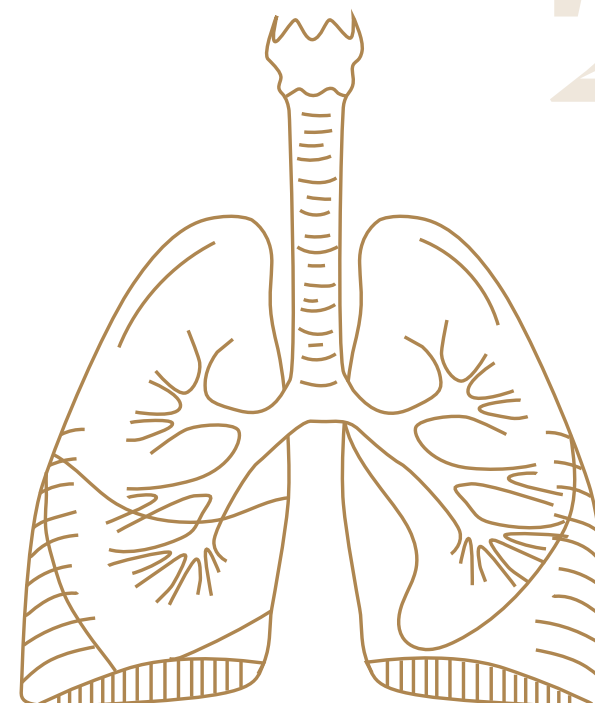
2009

- First percutaneous closure of the left atrial appendage using the Watchman device performed in Asia
- First robotic hybrid operating theatre in Southeast Asia (pictured above)
- First magnetic navigation system for complex arrhythmias in Southeast Asia
- First Heart Mate II implantation in Singapore (pictured right)
- First combined heart and liver transplant performed in Asia with SGH
- First percutaneous aortic valve replacement performed in Asia



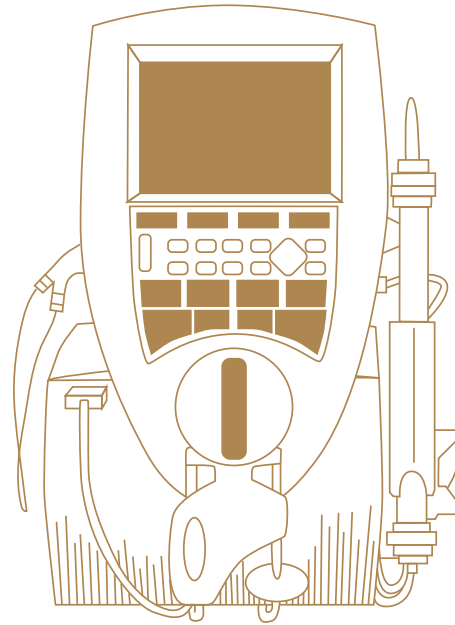
2010

- First robotic-assisted lobectomy in Southeast Asia
- SingLIVE partnered EuroPCR to launch inaugural AsiaPCR-SingLIVE (pictured below)



2011

- Successfully created beating heart cells from patient's skin
- First MitraClip procedure performed for patients with heart valve problems
- First Aquaphereis introduced for heart failure patients with fluid overload in Asia (pictured below)



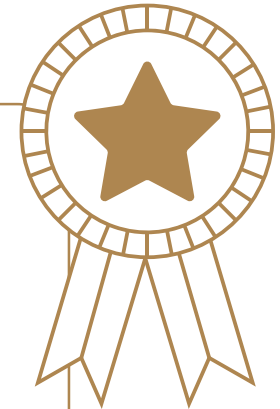
2012

- First third generation heart pump, the HeartWare HVAD implantation in Singapore
- Set up Cardiovascular Academic Clinical Programme
- First Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC) human heart cell model developed in the world to study inherited heart muscle disease associated with Sudden Cardiac Death
- First successful transapical transcatheter mitral valve-in-valve implantation (pictured below) performed in Asia



2013

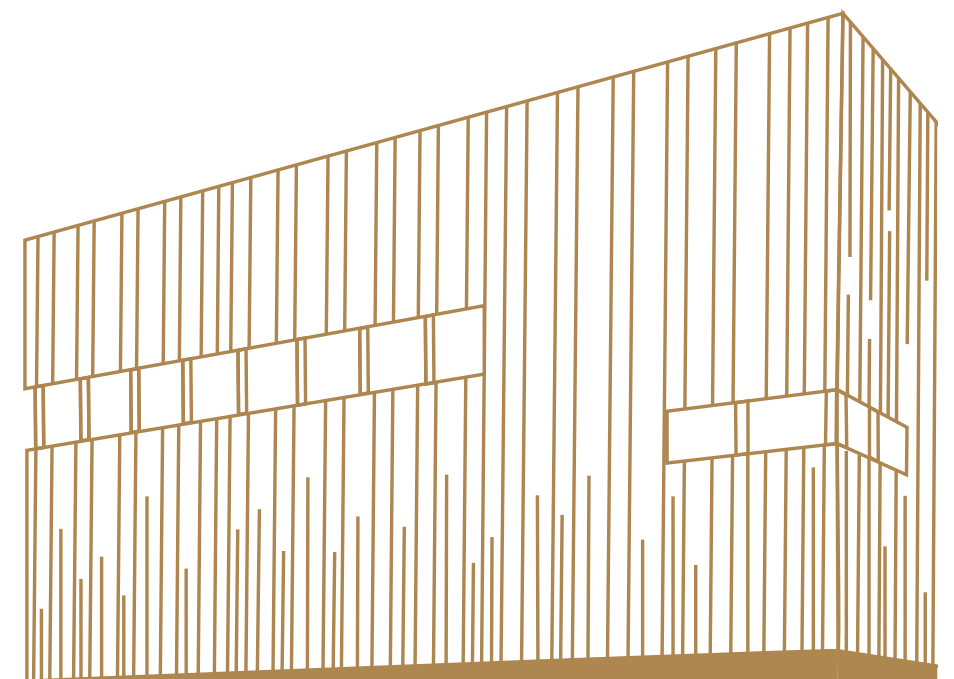
- First to reverse the effects of a gene mutation in Type 2 Long QT Syndrome in patient-specific heart cells in the world



2014

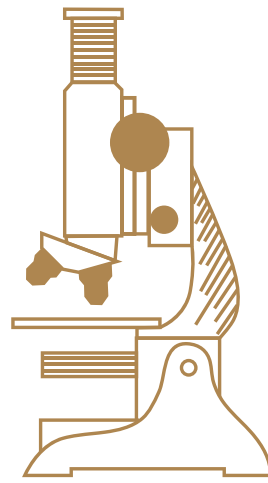


- New building at 5 Hospital Drive began its operations (pictured left)
- National Heart Research Institute Singapore (NHRIS) officially launched
- First Subcutaneous Implantable Cardioverter Defibrillator implantation in Singapore





2015



- First global diabetes registry in the world jointly created with American College of Cardiology
- Raised more than \$760,000 from the inaugural NHCS Heart To Heart Gala 2015
- SAF Cardiac Fitness Centre at NHCS officially opened



2016

- Developed cardiac gene sequencing panel with Imperial College London to test 174 genes in 17 inherited cardiac conditions
- Women's Heart Clinic officially launched
- Discovered gene mutations in Titin that affects the heart function in healthy Asians

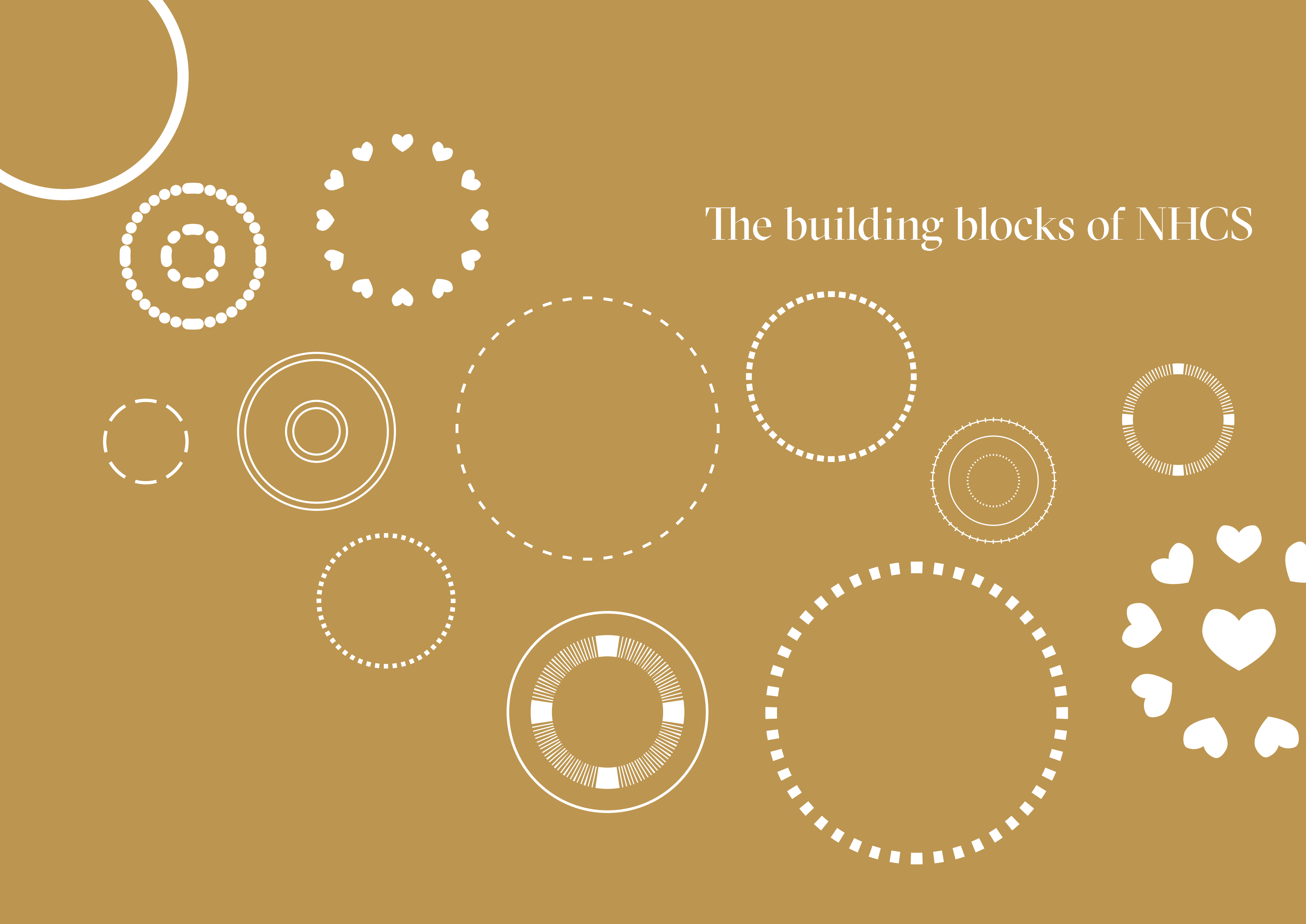


2017



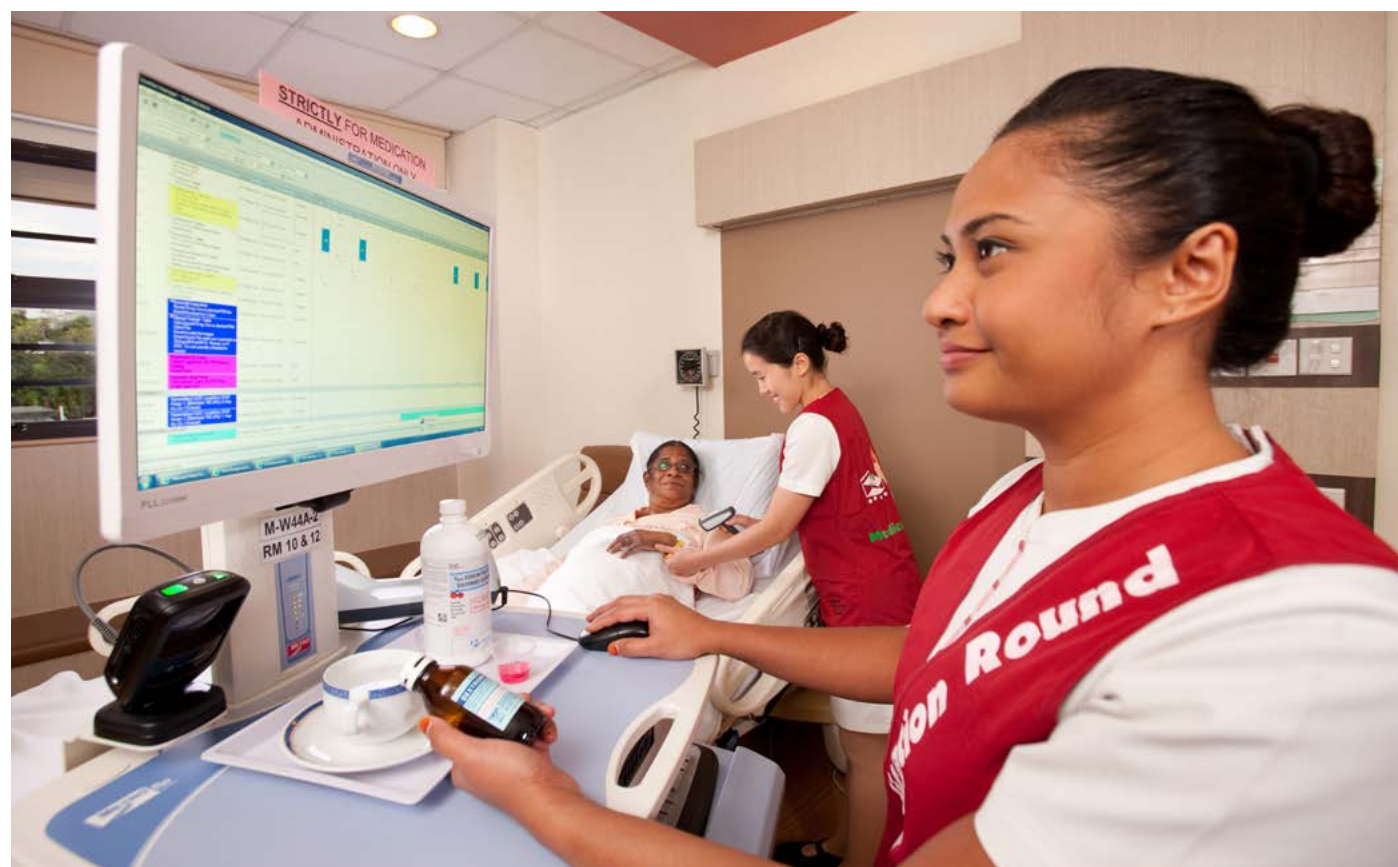
- Pioneered front-loading for tests and open access protocols with SingHealth Polyclinics

The building blocks of NHCS



Patient Care

Innovate. Improve.
For better patient care and experience.



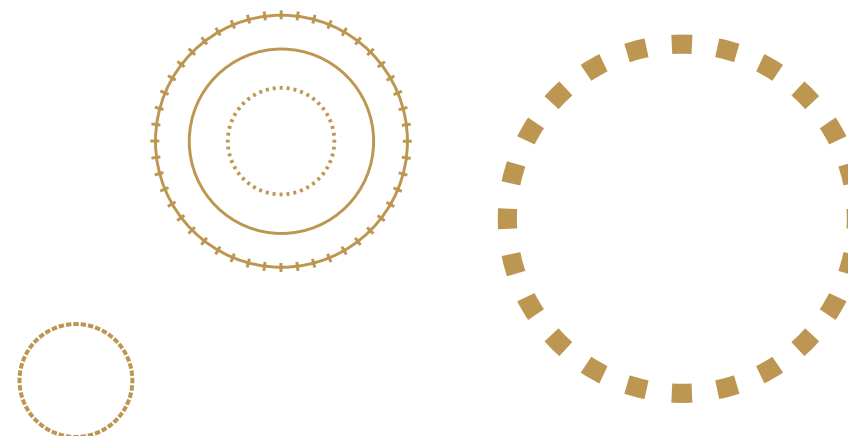
Shortened process for quicker diagnosis



NHCS sees 5,000 patient referrals a year from SingHealth Polyclinics, of which only 30% of the referrals were due to chest pains and only one third of these cases showed significant cardiac abnormalities. A typical referral from the polyclinic would entail patients visiting NHCS a few times, from an initial assessment, to going for a test and arriving at a diagnosis. The entire process may take several months. Since the end of 2016, NHCS leveraged on a team of cardiovascular specialists to pre-order diagnostic tests for patients based on their referral letters and electrocardiogram reports so that patients will undergo the diagnostic tests prior to their doctor consultation. This shortens the process and saves the patients a visit to the outpatient clinic.



To further improve the outpatient process, NHCS established an Open Access Protocol (OAP) with pre-established set of algorithms, allowing doctors at SingHealth Polyclinics to order cardiac diagnostic tests for patients who meet the criteria for OAP pathway at NHCS. Patients with normal test results will continue to be followed up at the Polyclinics while those with abnormal test results will be referred to NHCS. The process enhancements not only helped patients to save a visit to the outpatient clinic, but also helped to optimise resources and free up consultation slots to shorten waiting time for appointments.



SAF Cardiac Fitness Centre – a one-stop facility

In January 2015, the Singapore Armed Forces (SAF) Cardiac Fitness Centre opened its doors in NHCS to provide one-stop cardiac screening for pre-enlistees and national service men. Prior to the opening of this Cardiac Fitness Centre, National Servicemen (NSMen) had to shuttle between the SAF Medical Classification Centre, the Military Medicine Institute and one of the six public hospitals to complete their cardiac tests, which are compulsory before the enlistment for military training and operations. This entire process takes six months. With the centre, NSMen can be fast-tracked to more rigorous cardiac screening and necessary treatments.

First minimally invasive surgery in Asia for mechanical heart assist device implantation

Medical technology has improved by leaps and bounds. The mechanically-powered Left Ventricular Assist Device (LVAD), which serves as an external power source for a failing heart, has become more advanced and smaller. It can be considered as a minimally invasive procedure now. In 2001, NHCS performed Singapore's first LVAD implantation and in September 2014, NHCS did the implantation of this new and smaller device, which has a smaller incision and leaves the sternum largely intact. This surgery allows the patient to recover faster, and minimises the need for blood transfusions during surgery, which makes the patient more amenable for future heart transplantation.

First robotic hybrid operating theatre in Southeast Asia

In 2010, NHCS opened the region's first Hybrid Operating Theatre (OT), an evolution of how cardiovascular diseases were treated by integrating minimally invasive procedures with imaging technology and endovascular techniques. Conventional operating theatre environments are not designed for modern-day cardiovascular procedures, and lacked the requisites of imaging and procedural technologies required for seamless synergy. The Hybrid OT helps to facilitate increasingly complex procedures performed by the interventional cardiologist, with support from the surgical team.

This Hybrid OT has resulted in capabilities to provide patients with more minimally-invasive procedures, fewer surgical complications, shorter hospital stays, faster recovery time, and improved patient outcomes.

First percutaneous aortic valve replacement in Asia

77-year-old Mr Tang Yat Cheong was the first patient in Asia to undergo Transcatheter Aortic Valve Implantation (TAVI) procedure in 2009. He was suffering from a stenosis but was unable to have another open heart surgery as he had a coronary artery bypass graft surgery when he was 62. TAVI was thus the only viable option for him. While the two-hour procedure was a success, it was unpredictable on how long the prosthetic valve inside his heart could last. Fast-forward to 2018, Mr Tang is doing well to take care of not only himself, but also his wife.

First combined heart and liver transplant in Asia

In a surgery lasting 12 hours and 20 minutes, a team of 50 medical staff from NHCS, SGH and NCCS successfully completed Asia's first heart and liver transplant in April 2009. Retired pastor, Lau Chin Kwee was diagnosed with a rare genetic disorder, which left him with little chance of survival. His best bet was a double transplant, a never-before-seen procedure in Asia. The team began first with the heart transplant, which lasted under four hours, followed by the liver transplant, which took another five hours. This unprecedented dual transplant extended his life for a few years before he passed away two weeks before the fourth anniversary of his transplant.

First Homograft Bank in Singapore

In 2008, NHCS set up Singapore's first National Cardiovascular Homograft Bank, to recover, store and provide donated human heart valves, vascular tissues, and tracheas to local patients. In 2012, the homograft bank became the first tissue bank outside of North America to be accredited by the Association of Tissue Banks. As of 2018, the bank has an average of 10 consented donors a year.

Advancing medicine – the Mitraclip

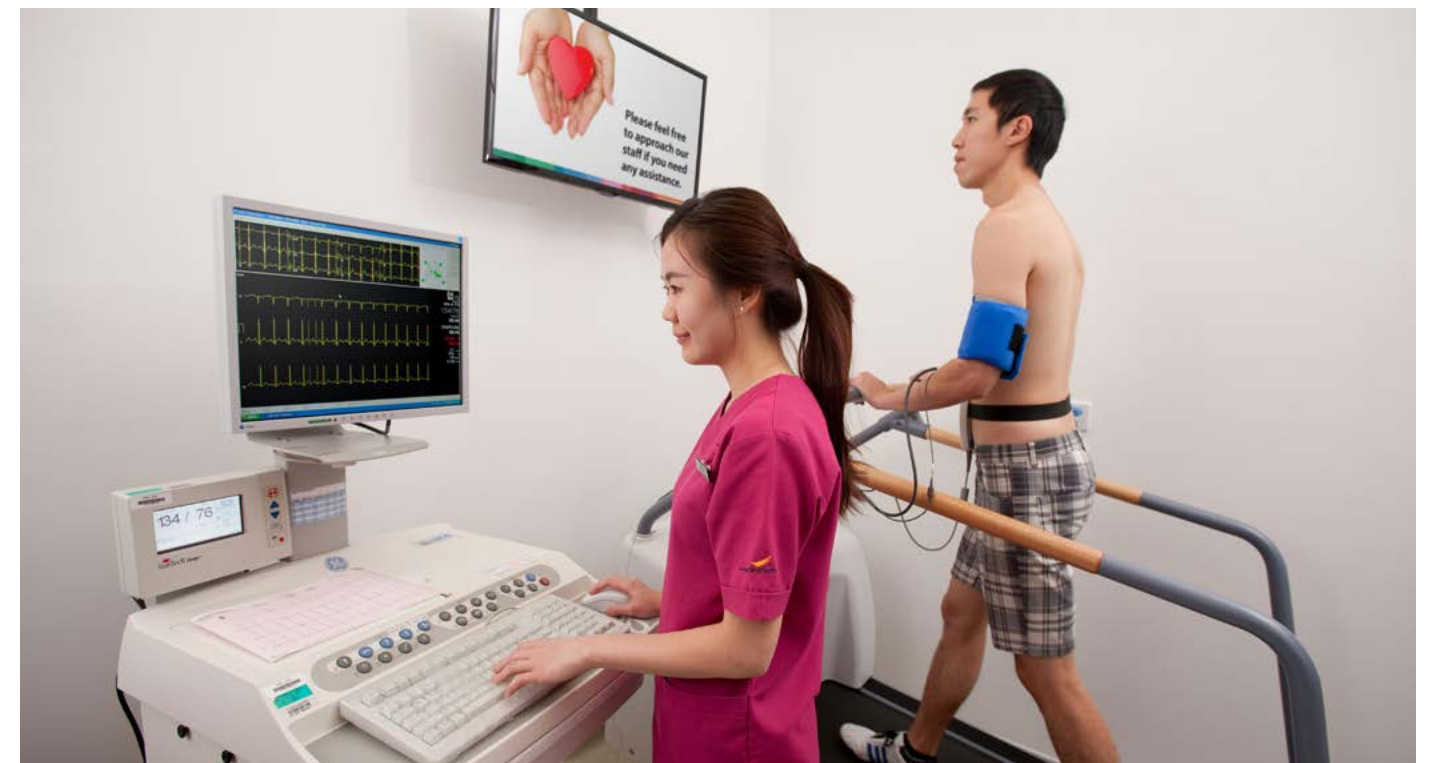
As the population ages, it is imperative that the medicine evolves to meet the needs of our ageing population. In 2011, NHCS introduced a new procedure to treat mitral valve regurgitation, a condition where the mitral valve does not close properly, causing blood to flow backwards into the heart. The new procedure provides a non-surgical option for patients who are unable to undergo the open heart surgery. To date, 91 have undergone the Mitraclip procedure since its introduction in 2011.

Pioneering the Subcutaneous ICD

In 2014, NHCS pioneered the use of a new procedure to help patients who are at risk of sudden cardiac death but are unsuitable for the conventional implantable cardioverter defibrillator. The Subcutaneous ICD (S-ICD), a minimally invasive procedure, involves a pulse generator that is implanted on the left side of the chest, outside the skin, with a lead implanted via a subcutaneous approach.

New procedure to treat congenital heart defect

In June 2018, NHCS introduced a minimally invasive procedure, the Melody Transcatheter Pulmonary Valve (TPV) implantation, which treats congenital heart defects without open-heart surgery. The TPV seeks to replace valves that are leaky and cannot close properly. The first patient who underwent TPV procedure, Mr Alvin Poh, 27, was discharged with a clean bill of health after five days. Mr Poh underwent his first heart surgery at the age of two and has since undergone two other surgeries to replace his heart valves. The novel treatment is an alternative to a fourth heart surgery, which would have posed exponentially higher risks, on top of Mr Poh's already tired mind, heart and body. This Melody TPV procedure was performed in London since 2000 and more than 10,500 patients worldwide have been implanted with this valve.



New building. New beginning.



2014 – The official opening of NHCS at 5 Hospital Drive

Some 300 guests witnessed the official opening ceremony of NHCS, as it ushered in a new chapter of heart-care excellence. The momentous occasion was graced by Prime Minister Lee Hsien Loong, Minister for Health Mr Gan Kim Yong, SingHealth Board Chairman Mr Peter Seah and SingHealth GCEO Prof Ivy Ng.



The new building was operational in March 2014, with an expansion in the specialist outpatient clinics. 38 consultation rooms were built in with improved patient visit flow to provide a more conducive and seamless experience for patients. On our first day of operations, senior leaders and staff welcomed and guided patients around the new premises.



2013 – The Topping Out Ceremony

2013 saw the successful completion of the NHCS new building. To commemorate this milestone, NHCS hosted a Topping Out ceremony, signifying the end of structural construction. As a symbolic gesture, Minister for Health Mr Gan Kim Yong and senior leaders of SingHealth and NHCS were invited to imprint their signatures onto a final piece of the building – a piece of the roof structure which was displayed today on Level 8.

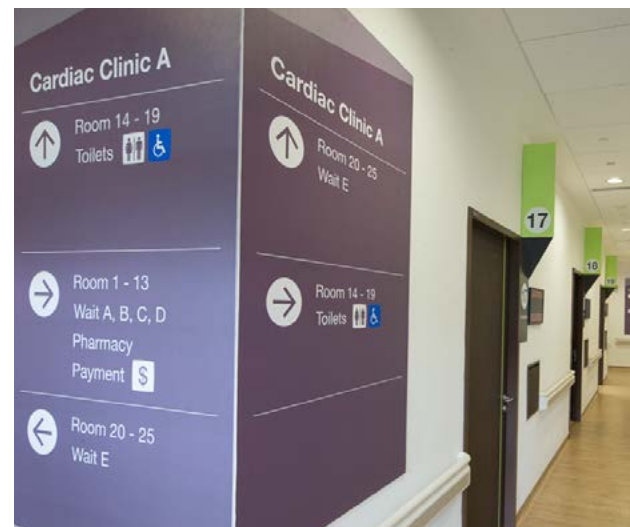
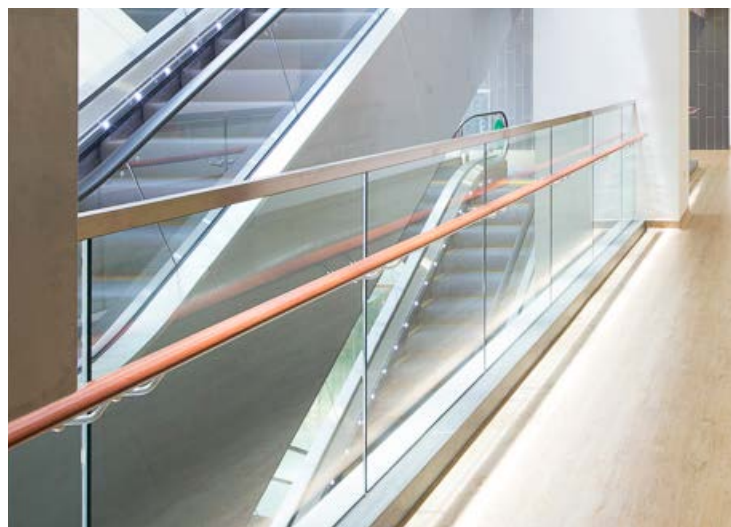




2012 – Unveiling age-friendly features to better serve elderly patients

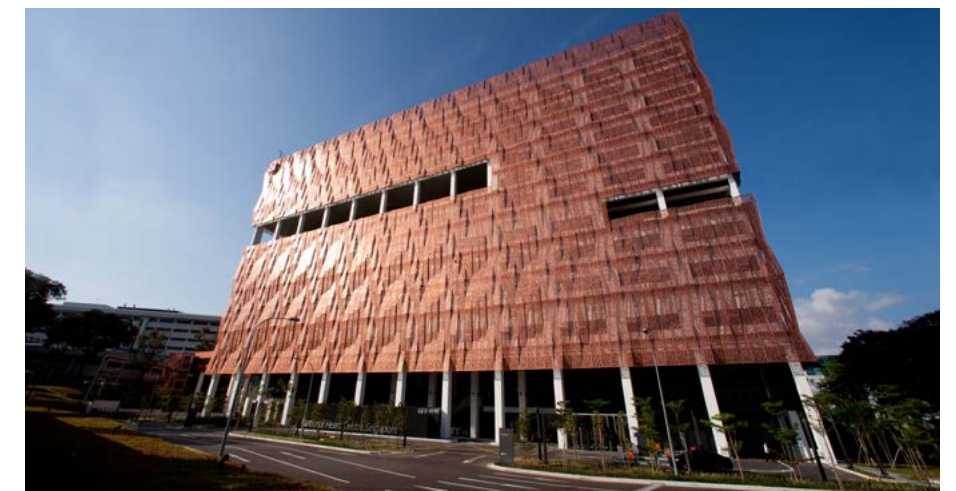
In July 2012, NHCS unveiled a suite of age-friendly features which were built into the design of the building. The features were designed with careful considerations for the needs of the ageing population including incorporating key features to enhance safety, accessibility, comfort and wayfinding for the elderly within the new building. Other key features included recessed counters for wheelchair users, cantilever signages to enhance ease of wayfinding, and ample handrail support along the corridors.

To further enhance the age-friendliness of its new premises, staff were encouraged to attend a specially designed age-friendly workshop, where they experience the challenges that elderly patients would face to better understand their needs.



2012 – Attaining BCA Green Mark Platinum Award

NHCS new building attained the BCA Green Mark Platinum Award in 2012. Many environmental friendly features were integrated into the building such as energy efficient air-conditioning system, motion-activated light systems, rain harvesting fixtures and ample charging stations for electrical cars. These initiatives helped to save some 6,500,000 kWh of energy and 12,000 m³ of water annually. To create a healing environment, about 2,200 square metres of greenery in various terraces and open spaces were designed - helping to cut down the building's carbon emission by 3,300 tonnes.



2009 – Breaking grounds for the new building

A groundbreaking event was held on 28 March 2009 to mark the commencement of the construction of the NHCS new building. The ceremony was officiated by the former Health Minister Khaw Boon Wan. The new building was planned and built to handle future higher demand.



Research

Evidence-based research is pivotal in the discovery of causes, treatment and prevention of heart diseases. NHCS is committed to bringing about breakthroughs to improve heart health and new treatment.



Developing cardiac gene sequencing panel



In 2015, NHCS collaborated with a team of international researchers to create a new genetic screening tool that enables scientists to identify mutated genes inherent in cardiovascular diseases in a faster and cost efficient way. The TruSight Cardio Sequencing Kit was jointly developed by Tanoto Foundation Professor of Cardiovascular Medicine, Professor Stuart Cook, Director of National Heart Research Institute Singapore (NHRIS) and Senior Consultant at NHCS, and a team at Illumina, one of the world's leading developers of life science tools and technology. The kit enables researchers to sift through 174 genes associated with 17 inherited cardiovascular conditions quickly, without compromising scientific accuracy. With this panel, blood samples could be processed into genetic data for analysis within 24 hours at a very affordable cost of about US\$1 per gene.

Leading multinational study in the discovery of gene mutations in Titin



In 2015, Professor Stuart Cook and a team of multinational researchers concluded that a mutation near the end of the Titin gene would cause dilated cardiomyopathy, while mutations along the other parts of the gene would not. The breakthrough discovery was a great leap in the management of the hereditary condition that could contribute to early discovery and better management of individuals. Since then, NHCS and NHRIS have been working on a database that would replicate the same genetic research on the Asian genome. The Asian-centric database would support and push the progress of cardiovascular medical research in the region, particularly shedding insights on how the Asian anatomy and genome cope with the disease.

Creating the world's first global diabetes registry

In partnership with the American College of Cardiology, NHCS established the first global cross-specialty clinical diabetes registry in 2015. Named ADORE (Asian Diabetes Outcomes Registry), the registry aims to facilitate the designing of treatment guidelines for the local population. The registry is a vital resource for Singapore's efforts in its war against diabetes. ADORE which is led by NHCS Senior Consultant, Professor Carolyn Lam, covers sites across Southeast Asia.

Formation of NHRIS

The National Heart Research Institute Singapore (NHRIS), a joint-collaboration between NHCS and Duke-NUS, began operations in 2014. Nested within the NHCS premises, NHRIS aims to focus research efforts on cardiovascular conditions in the region. Occupying about 4,000 square metres of space, NHRIS is equipped with state-of-the-art DNA and genetic analysis, and processing equipment for the facilitation and performing of research projects and trials.

Creating beating heart cells from patient's skin

In 2011, a team of researchers and scientists at NHCS successfully created beating heart cells from a patient's skin cells - a gigantic leap in research advancement. Known as Human Induced Pluripotent Stem (hiPS) cells, these cells could be used to replace damaged heart muscle cells of heart failure patients, alleviating symptoms such as breathlessness. The discovery could potentially prolong the life of a patient before the need of a heart transplant. Since then, hiPS cells have been used to create a human heart cell model, enabling further research into a heart muscle disorder (arrhythmogenic right ventricular cardiomyopathy) and drug therapy for the Type 2 Long QT Syndrome, which displays irregular heartbeats.

In 2017, the research team found an existing drug, which was previously used to treat cystic fibrosis, is effective in controlling the irregular heartbeats.



Training & Education

As a part of the SingHealth Duke-NUS Academic Medicine partnership, we strive towards new discoveries, learning and care innovation, all with one goal in mind – that is, to bring about sustainable medical excellence for improved patient outcomes.



Two decades of educational excellence in interventional cardiology



Over the last two decades, NHCS has pioneered many firsts in clinical care, medical research, training and education. As the leading cardiovascular centre in the region, NHCS is committed towards raising the standards of cardiovascular medicine and care and continuously seeking opportunities to advance the skills and knowledge of the cardiovascular community.

The Singapore LIVE (SingLIVE) interventional cardiology conference started 28 years ago, remains to be one of Asia's pre-eminent annual courses in cardiac interventions. Inaugurated in 1989, SingLIVE started with just 200 participants. The flagship event now, sees about 2,000 delegates and speakers from all over the world every year.

Since 1989, the conference has grown in scale and dimensions, with innovations and improvements in the treatment of cardiovascular disease by interventional means. At present, the course includes not only cases and teaching sessions on percutaneous coronary intervention, but also treatments for structural heart diseases, including heart valve replacement through the TAVI procedure.

NHCS partnered with EuroPCR in 2010 to jointly organise the first Asia PCR- SingLIVE Cardiology Conference in Singapore. Leveraging on EuroPCR's extensive reach and network in Europe, the conference brings cutting edge techniques and devices in interventional cardiology to the doorsteps of Asian doctors and paramedical staff, without the need to travel long distance to Europe.

Organising the SingVALVE Conference



Inaugurated in 2010, the biennial SingValve conference featured an international panel of experts, providing in-depth lectures and novel techniques, demonstrated through a live-surgery. This conference was started by NHCS Senior Consultant, Department of Cardiothoracic Surgery Professor Chua Yeow Leng, to share on the comprehensive multi-disciplinary approach to valvular heart disease surgery by the collected experience and expertise of NHCS.

Promoting heart care awareness within Singapore youths



NHCS organised the SingYouth Heart Challenge and Lecture yearly from 2015 to 2018 to educate students on cardiovascular disease, the prevention and treatments. The event encouraged students from junior colleges and secondary schools to research into cardiovascular related topics and submit them as abstracts. The students had opportunities to hear from the NHCS leading experts and accomplished pioneers on the latest treatments and medical research for cardiovascular disease as well as the set up of the specialty and the types of landmark surgeries.

Forerunners of CTO specialised training



In efforts to improve local and regional standards of care in the area of Chronic Total Occlusions (CTO), NHCS hosted its first CTO Interventions Live Course in 2009. Aside from local faculty, the course also featured lectures and live interventional demonstrations by renowned Japanese experts, Prof Masahiko Ochiai and Dr Osamu Katoh. Over the last nine years, the conference has solidified its presence as the premier specialised teaching course on retrograde techniques and antegrade approaches for complex CTO cases.

From strength to strength



National Outstanding Clinician Awards

Our clinicians have been recognised with several national awards.

Dr C Sivathanan, Director of Mechanical Circulatory Support, Heart and Lung Transplant Unit, received the National Outstanding Clinician award in 2011, which commends individuals who have dedicated at least 15 years of service in healthcare for their exceptional contributions to clinical work.

Prof Terrance Chua, Medical Director, was honoured with the same award in 2013.

Prof Koh Tian Hai, Senior Advisor, received the National Outstanding Clinician Mentor award in 2015, for his exemplary contributions in the training of young clinicians and clinician scientists by mentorship or through his academic position.

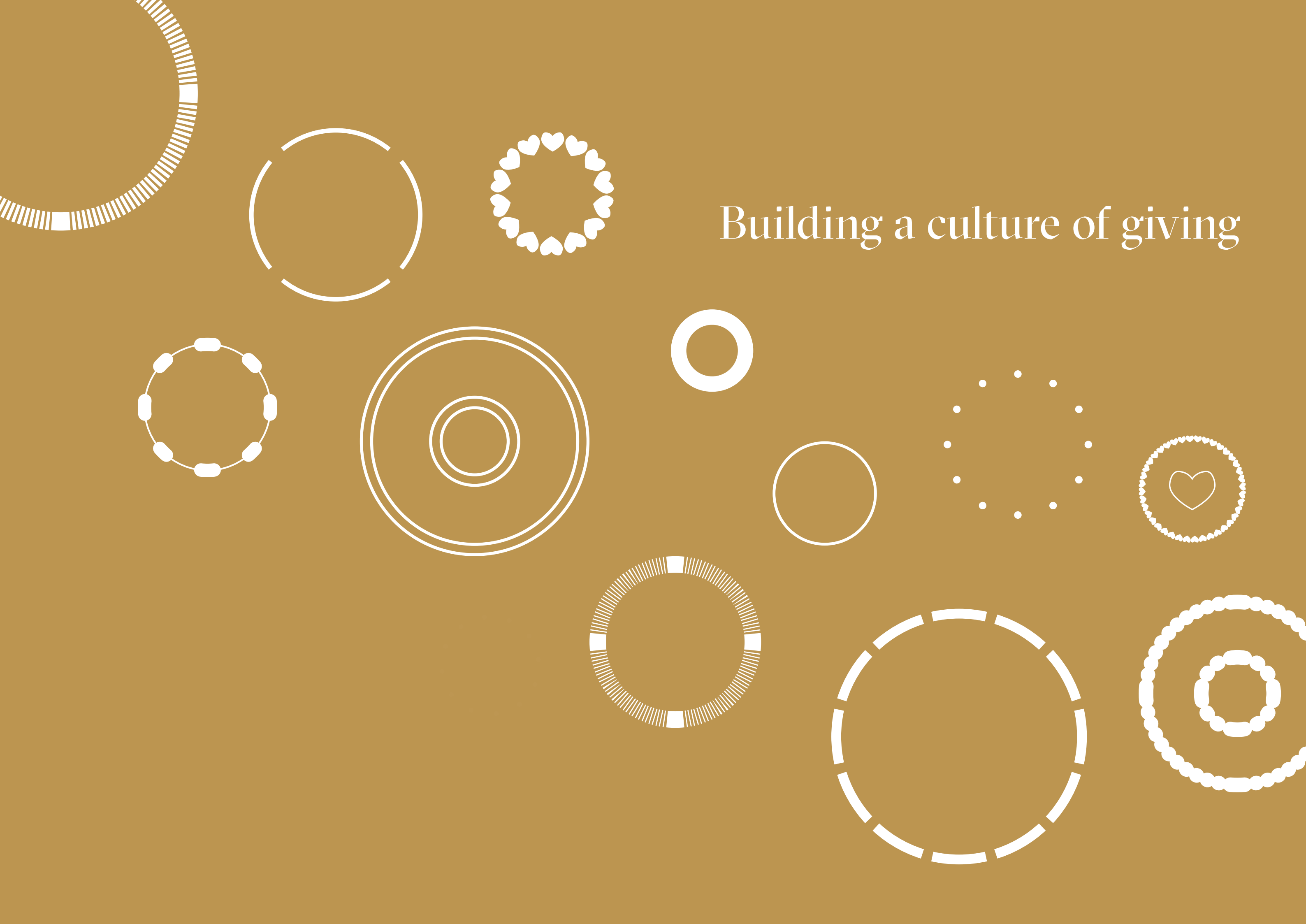
These awards belong to the National Medical Excellence Awards, inaugurated in 2008, a national-level award recognising outstanding contributions in the advancement of healthcare, improvement in standards of patient safety and quality of care, which ultimately improves people's lives.



President's Award for Nurses

Four of NHCS' nurses have been honoured by the President's Award for Nurses, which recognises exemplary nurses who show outstanding professional competence, resourcefulness, and innovation in their work. Prof Lim Swee Hia, Ms Tan Ah Pang, the late Ms Lim Suh Fen and Dr Teo Lee Wah were honoured with this award, having proven to be role models with the ability to motivate and mentor younger nurses, and inspire others through community work.

Building a culture of giving



The Spirit of Giving

Providing stellar medical care does not end when a patient is discharged from our facility. NHCS is committed to ensuring that our patients are given continuous value-added care, and are dedicated to walk the journey of recovery with them.

It is a heavy mantle to take on, and we could not have done so without the benefactors and friends, who have been our partners, supporters and advocates of our causes.



Creation of the NHCS Heart To Heart Fund



NHCS took over the endowment funds of the Departments of Cardiology and Cardiothoracic Surgery from SGH in July 1998 and renamed it the 'NHCS Heart To Heart Fund' in January 2010.

NHCS had its inaugural fundraising with its patients in 2009 through a direct mailer (also known as Annual Giving) and raised close to \$50,000 in the first four months. Since then, the direct mailer has become one of the mainstays for NHCS Heart To Heart Fund retail fundraising.

Giving the Gift of Life



The inaugural NHCS Heart To Heart Gala themed "The First Beat" held in 2015 at Conrad Centennial Singapore raised over \$760,000 with the generous support and fervent advocacy of the partners. A second NHCS Heart To Heart Gala was held in 2016 at the same venue decked with flora and fauna, brought their vision of an 'Enchanted Garden' to life. The theme symbolised the creation of a sustainable health ecosystem and the opportunities for our patients to receive a new lease of life.



The third NHCS Heart To Heart Gala in 2018 was held in conjunction with NHCS' 20th Anniversary celebrations. The dinner was exquisitely curated by celebrity and Michelin-starred chefs Julien Royer, Beppe De Vito, Cheung Siu Kong, Melina Yong and Jean-Georges Vongerichten, with invaluable input from Dr N.K. Yong as the wine consultant. The valuable contributions from several volunteer members including Mrs Melina Yong, Ms Lynn Yeow, Mr and Mrs David Lee, Dr Melanie Chew, Mrs Aileen Boon and Mr Bill Foo, have raised more than \$2.3 million.

Garnering local support for fundraising



No gift is too great or too small when it comes to helping patients.

In recent years, NHCS fundraising has gained much traction, with ardent support from staff, Annual Giving from grateful patients, and myriad outreach events to the local community.

NHCS staff truly go the extra mile for our patients. Not only do all colleagues put patients at the heart of all they do, they make donations, volunteered time and energy to make our fundraising events unmitigated successes.

Over the last five years, NHCS has organised events to raise funds and awareness through partnerships with grateful patients, art galleries and artists. In 2015, father and son duo KY (also a patient) and Andrew held an exhibition in NHCS, with KY speaking candidly at a lunchtime talk on his health, his art and his journey with NHCS. In 2016, a photo exhibition was jointly organised by NHCS and Mr Low Seow Juan to raise funds for the needy patients. In 2018, a series of greeting cards was produced using the artwork of Mdm Wong-Mah Jia Lan, a patient of NHCS, to raise funds for the research projects undertaken by budding clinician scientists.

Hearts of Gold – The NHCS Council of Patrons

This Council was established to recognise individuals and corporations who have played a significant role in our philanthropy efforts to help improve cardiac health locally and globally.

The Council was launched by Finance Minister Heng Swee Keat at the NHCS Heart To Heart Gala in 2018 with the aim of bringing like-minded individuals together to further the mission of advancing cardiovascular care through medical research and education.

Major gifts and their part in research breakthrough



Many of NHCS' research breakthroughs would not have been possible without the pivotal support from our partners. The first major gift, from the Goh Foundation, enabled us to build the necessary research infrastructure – the cornerstones – for today's NHRIS. The Goh Foundation, under the leadership of Chairman Goh Cheng Liang, gifted us with \$10 million a decade ago, in honour of NHCS' 10th anniversary. While some of the monies were invested into building facilities for research work, some of the funding was also channeled into various research projects, and have yielded breakthroughs like a Novel Cellular Model for Studying Inherited Arrhythmogenic Diseases and the creation of the Induced Pluri-potent Stem Cells.

In 2013, NHCS partnered with the Tanoto Foundation in the creation of the Tanoto Foundation Cardiovascular Professorship. Prof Stuart Cook, Director of the NHRIS and Senior Consultant at NHCS, was conferred the Tanoto Foundation Professorship in Cardiovascular Medicine and another gift of \$500,000 to advance his Cardiovascular Disease research in the genetics. His research has yielded two major breakthroughs, one in the discovery of the Titin Gene and its effect on hereditary dilated cardiomyopathy, and the other on the discovery of the protein IL11, which is the cause of scarring on organ tissue leading to organ failure. The discovery of IL11 being the cause to organs scarring enables us to work towards developing a drug therapy that will positively impact our patients' lives.

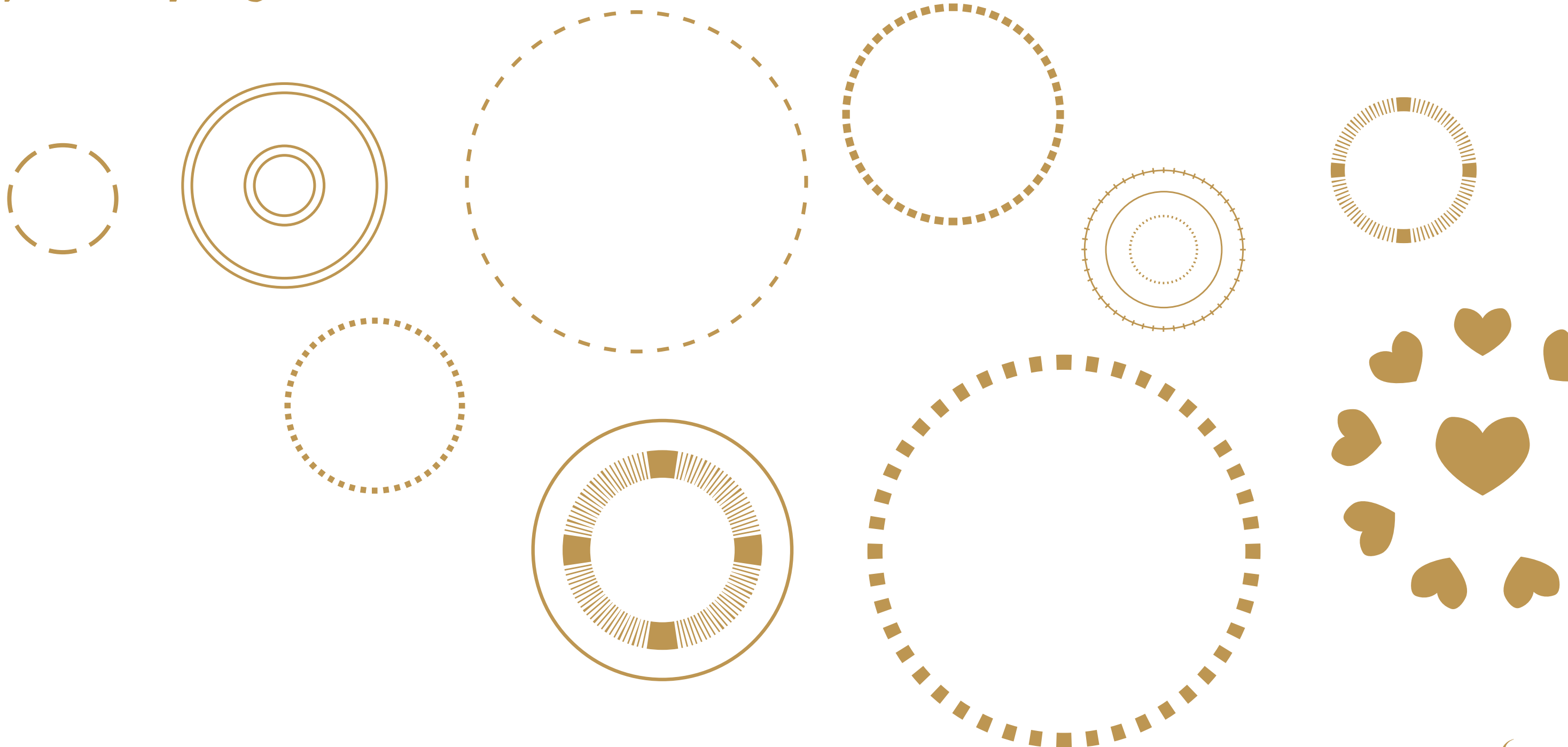
In 2015, the Lee Foundation honoured NHCS with a gift of \$950,000, supporting the SingHeart Research Project. SingHeart seeks to enable better understanding of the progression of cardiovascular disease in Asians, to predict cardiac risks and develop pre-emptive treatment strategies. The ultimate aim is to develop a cardiovascular risk assessment tool applicable to people in the Asian regions.

Pioneer Cardiologist Dr Charles Toh set up the Charles Toh Cardiovascular Fellowship in 2015, in support of the Cardiovascular Academic Clinical Programme. This gift funds the cardiovascular research and education initiatives undertaken by NHCS' budding clinician scientists, and presently funds projects by Dr Ye Lei and Dr Sebastian Schafer.

In celebrating New Toyo's 20th anniversary as a public listed conglomerate, a generous gift of \$1M was donated to the set up of New Toyo Fund for Cardiovascular Research and Education which will go towards supporting various research and education initiatives undertaken by our healthcare professionals.

These benefactors were honoured as founding members of the NHCS Council of Patrons.

The faces of NHCS journeying as one heart



“Nursing continues to play a proactive role in identifying and meeting the emerging needs of our healthcare population as we strive to build a strong and cohesive nursing community. We need to be ambitious and bold to look beyond how collaborations can fuel innovation and complement one another to bring about better patient care and advances in nursing profession. **To do what we love and love what we do have always been my credo in nursing and in life.**

It is my passion in nursing that made me constantly challenge status quo to do things differently. My utmost gratitude and sincere thanks to Prof Koh Tian Hai, Prof Terrance Chua and all who have journeyed with me through the years and propelled the organisation to what it is today.”

- Assoc Prof Lim Swee Hia
Senior Director, Special Projects (Former Director of Nursing)



“Over the years, nursing profession has progressed tremendously by constantly pushing boundaries of clinical excellence with research and evidence-based theories to improve treatments and management of illnesses. I am fortunate to work with healthcare professionals who are dynamic, like-minded and dedicated with common goals to providing exemplary patient care. The most significant milestone in my career was having the opportunity to set up the Cardiac Rehabilitation Clinic in NHCS (then Mistri Wing). The programme grew from strength to strength with well trained nurses and physiotherapists and even surpassed most international standards. **Putting patients at the heart of all we do, we will advance the frontiers of medicine and bring better care.**”

- Chong Thye
Assistant Director, Nursing



“I’m passionate in helping people and making a difference in their lives. Working in the healthcare industry allows me to fulfil my desire to help others. NHCS has presented me with many opportunities for advancement and growth, alongside my colleagues, many of whom I consider family. In the face of challenges, we are able to respond as one with strength of spirit and unity. **Together, we will persevere and continue to serve our patients with the highest standards in quality care.** We have come this far and will continue to pursue excellence with positivity and camaraderie, with the strong leadership and support from the cluster.”

- Yvonne Yeo Hwi Chien
Senior Staff Nurse, Cardiac Clinics



“I have been blessed in many aspects and I’m thankful for all the love, care and opportunities given by NHCS. **I see nursing as a way of giving back to the society and no action is too small to make a difference in someone’s life.** This has driven me to give my best in caring for the patients.”

- Lim Chuan Kah
Principal Enrolled Nurse, Coronary Care Unit

“It has been my great privilege to have seen NHCS grow from a cardiology unit, to a full-fledged centre housed in our own building. As a healthcare assistant, I am glad to be able to help our patients in their most vulnerable moments. Once, a patient collapsed during my portering journey, and I had to work together with the doctor to rush the patient back to the ward. **NHCS treasures each staff member, and we know that no job is too small, or insignificant when it comes to the care of our patients.** Together we grow as a team and as a family.”

- Saedah Bte Gambus
Health Care Assistant, Cardiac Catheterisation Lab



"Being a nurse for 55 years, **I am extremely proud to see how nursing profession has transformed over the decades and NHCS has pushed boundaries for better patient care.** Nursing plays a pivotal and integral role in improving patients' lives; caring for them throughout their health journey.

We are proud to have groomed a pool of Advanced Practice Nurses and Resident Nurses who are the first in their vocation to specialise in specific disease conditions and provide complex nursing care to patients. I am thankful to be able to work with great colleagues from the medical and nursing professionals such as Assoc Prof Lim Swee Hia, Chief Nurse Tay Ai Liu, MD Prof Terrence Chua, ADN Foo Lee Lian and SNM Foong Jia Yi who are compassionate and teach with their hearts."

- Liew Siok Moey
Nurse Clinician, Ward 56



"Over the years, NHCS has grown tremendously, albeit from a small beginning. I was fortunate to nurse the first heart transplant patient, and have since seen how NHCS has grown and accomplished. **NHCS is never complacent and continues to improve despite our manifold achievements.**"

- Maliga D/O Riaki Chinniah
Nurse Clinician, Cardiothoracic Intensive Care Unit



"As a specialised centre for heart diseases, NHCS has flourished and grown alongside the advancement of medical technology to meet the needs of most complicated heart problems, in particular, the treatment of heart diseases with percutaneous interventions. We, nurses are trained to think on our feet, react according to the situation presented, and respond with critical and meticulous thought. **I am happy to be involved in the mentoring of new nurses and together, we aspire to continuously improve ourselves in clinical knowledge and patient care.**"

- Tina Teo Poh Tin
Senior Nurse Manager, Cardiac Catheterisation Lab



"NHCS has seen many milestones and many 'firsts' in the medical advancement. The Left Ventricular Assist Device (LVAD) implemented by NHCS in the region, has been by far the most impactful to patient care; giving advanced heart failure patients opportunity to have as near a normal life as possible. The devices of the past were bulky and patients had to be hospital-bound. Today, a LVAD surgical implant can be done in 3-4 hours, and our patients are taking care of themselves and leading fulfilling lives in the community. **NHCS has been at the forefront of cardiovascular care for these two decades, and it has been a great honour to have walked this journey with my colleagues.** To many more great years to come."

- Ismail Bin Mohamed Tahir Sheriff
Senior Nurse Clinician, Nursing Development Unit

"NHCS has come so far through the years – from the opening of our new building to the advancement in medical care and improvement in patient care. **The most fulfilling moments for me at NHCS are the opportunities to engage and interact with our patients and being able to care for them.** The collaborative mindset and environment encourage learning and sharing across multi-disciplinary teams and colleagues in NHCS and SingHealth family. My journey with NHCS has been meaningful and rewarding and likewise, I strive to make a difference to our patients in their journey with us too."

- Kelly Chng
Pharmacy Practice Manager, Pharmacy



"I have been with NHCS for 12 years and **am constantly humbled by how patients have the strength to face and get through their adversities. Being able to walk this journey with them motivates me.** NHCS has made its mark in the area of genetic research where we are able to run clinical consultations, studying the genetic causes behind heart disease and heart failure. This allows our patients and their family members to receive appropriate screening for earlier diagnosis, interventions and better outcomes."

- Asst Prof Laura Chan
Consultant, Department of Cardiology



"The establishment of NHCS back in 1990 remains the centre's greatest milestone as it paved the way for innovation and enterprise. It was enriching and exciting to be able to work with various experts in the field of cardiothoracic surgery, especially in the changing landscape of mechanical heart assist devices. The setup of the Mechanical Assist Heart Device Programme was a key development in the care for patients with advanced heart failure. The new generation of durable implantable rotary heart pumps help to reduce the mortality of those on heart transplant waiting list. **It is heartening to see patients recovering from serious illness and getting back to their families, and definitely a joy to be able to help them through the journey.**"

- Dr C Sivathanan
Director, Heart Transplant and Mechanical Assist Heart Device Programme



"In two decades, NHCS has established itself as a renowned centre in the world that provides quality heart care to patients, with significant achievements. **The greatest motivation is to be with our patients in their health journey – leading a healthy and normal life.** I believe with the strong institutional commitment to do even more, we will be able to bring about better care for our patients and break new grounds for the treatment of cardiovascular disease.

- Asst Prof Louis Teo
Consultant, Department of Cardiology

"NHCS 20th anniversary signifies our coming of age. The international and regional standing, recognition from patients and healthcare partners further affirm our commitment to patient care and our contribution to advances in cardiovascular health. **The next 20 years will be another exciting journey as we strive to achieve more. Let us meet every challenge with a spirit of conviction and courage.**"

- Assoc Prof Lim Soo Teik
Deputy Medical Director
Senior Consultant, Department of Cardiology



"During my time with NHCS since its early days, I have witnessed the institution's growth. My proudest moment was seeing the new building coming to fruition, with expanded service and capacity to do more than we could before. **I strongly believe that to give the best care to our patients, we must continue to seek and share knowledge, and my wish for NHCS is to cement itself as a global leader in training and education, and in research.**"

- Prof Koh Tian Hai
Senior Advisor and Senior Consultant, Department of Cardiology



"In the last two decades, NHCS has achieved not only many breakthroughs in cardiovascular research, but also a greater standard of care. This was brought about by greater synergies between the Departments of Cardiothoracic Surgery and Cardiology. **As we continue to work hand in hand, we will continue to blaze new paths and conquer new frontiers in the arena of cardiovascular medicine and treatment.**"

- Assoc Prof Aaron Wong
Head and Senior Consultant, Department of Cardiology



"The growth and expansion of NHCS' Heart Failure Programme, including the team from Mechanical Circulatory Support, Heart and Lung Transplant Unit, are the greatest achievements in NHCS. Started with a few patients, the programme has expanded with a support network of almost 100 Left Ventricular Assist Device (LVAD) patients, as well as multidisciplinary teams of doctors, surgeons and other healthcare experts, who play key roles in the lives of our patients. **Our vision for the next 20 years - to scale new heights and make an impact in heart health in the nation and region.**"

- Dr Tan Teing Ee
Head and Senior Consultant, Department of Cardiothoracic Surgery

"I'm proud of what NHCS has achieved so far, including the first heart and lung transplants in Singapore. It is immensely gratifying to see we have helped improve patients in their health journey. **My greatest motivation working in healthcare industry is the ability to make a positive impact in the lives of others, and having the opportunities to innovate and improve patient care.** I'm definitely excited to contribute to the good work we are doing."

- Asst Prof Ong Boon Hean
Consultant, Department of Cardiothoracic Surgery



"NHCS continues to innovate and improve in face of new technological advances. It has accomplished much over the last two decades in research breakthroughs, clinical processes and medical devices. To me, one significant milestone was our adoption of the clinical records system, ClinDocs, which streamlines documentation processes. It also allows staff to access relevant information required for the course of their work with ease, thus improving efficiency. **I am sure that NHCS, as one family, is always ready to take on new challenges and continue to grow, even as the healthcare landscape evolves.**"

- Kengadevi D/O Jeyaraman
Executive, Quality Assurance



"I am grateful to work in an organisation with a strong leadership team who cares for patients. It was a privilege to be part of the team that oversaw the opening of the SAF Cardiac Fitness Centre in 2015 – a collaborative project with the Singapore Armed Forces. **I am proud that NHCS, being Singapore's national referral centre for cardiovascular diseases is uniquely positioned to serve our nation and positively impact heart health in the region!**"

- Michelle Chew
Assistant Manager, Operations (MIP)



"NHCS was incorporated as a national specialist centre, before becoming autonomous. From a 4-storey building at Mistri Wing then, we have transformed and grown to a specialty centre spanning across 12 stories with inpatient facilities in SGH. The new NHCS building development project was the first project I embarked on when I joined NHCS in 2007. The completion of the building was one of the most memorable experience of my career. **The delight in our colleagues and the appreciation from our patients and visitors gave me a great sense of satisfaction.** I am extremely proud of our NHCS family and all that we have accomplished!"

- Victor Ang
Assistant Director, Operations (Support Services)

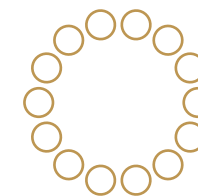
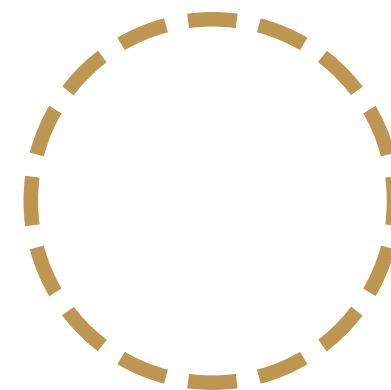
"In 2014, we moved into our new building, a one-stop service for our cardiovascular patients, and a top regional training, research and clinical facility. My journey with NHCS has been engaging and fulfilling. Over the years, I am privileged to have interacted and cared for many patients. Through this, I learnt that everyone has a story to their lives, and each story teaches me valuable lessons on self-improvement as well as ways to care for my patients. **The joy and satisfaction that comes from caring for them is unparalleled.**"

- Jasmine Ho Hui Min
Executive Medical Technologist, Vascular Laboratory



"It is heartening to work alongside colleagues who are passionate and caring – seeing how everyone cares for our patients in their health journey. This adds meaning to my work and the reason for me to be in healthcare. Being in NHCS for the last decade, I witnessed the formation of SingHealth Duke-NUS Academic Medical Centre and how NHCS expanded our clinical services and developed our capabilities in education and research. Though it had been an uphill journey, NHCS has continued to achieve many research breakthroughs and advancements in medical care; **all for one common goal that is to improve care for our patients.**"

- Clarice Ng Shu Hwa
Senior Medical Social Worker, Medical Social Services



"Being a part of the NHCS family has forged bonds of friendship for me and provided me with the opportunity to grow in knowledge and keep up with the rapidly advancing healthcare industry, through great mentors and leaders. There are no words that could describe the immense satisfaction and pride that comes from being able to assist post-operative patients to regain their strength, mobility and independence. **NHCS has always pioneered and remained the leader of heart care in the region and I look forward to continuing this learning journey with NHCS for many more years to come.**"

- Jessica Lee Si Qi
Physiotherapist, Cardiac Physiotherapy Services



One Heart

NHCS Song/lyrics
by Heartstrings, a three-piece band comprising
Muhammad Ibrahim Bin Zainal Akmar (Cardiac Radiology),
Dr Teo Hooi Khee (SingHealth's Cardiology Senior
Residency Programme) and Galvin Lee (Cardiac Laboratory)

Verse (1) They said it was going to be tough
However tall, however rough
We took it all in our stride-
To- make this our pride

We do more than just our best
We'll always stand up to the test
No matter how hard it may seem to be

Passion pushing us through the clouds
To reach the rainbows beyond

Chorus Let's move as One Heart
With passion, trust and aspirations
Moving forward
2 decades, 3 and many more

Verse (2) With faith, hope and endless dreams
We all belong in this great team
Let's pave the way for the young
To – learn and grow

We do more than just our best
We'll always stand up to the test
No matter how hard it may seem to be

Passion pushing us through the clouds
To reach the rainbows beyond

Chorus Let's move as One Heart
With passion, trust and aspirations
Moving forward

Bridge 2 decades, 3 and many more

Dream together
Soar ahead
Walk together hand in hand

Electric Guitar Intro riff

Rap 1: From humble beginnings to world
class stand
Never waver, pushing forward now
that's the plan
With our hands on our hearts
And minds all as one
Hearts as one, And that's our lore
ur mission and our vision guiding
all that we do
Compassion trust and aspirations
we stick to it like glue
Unlike glue, we don't dry out but
we stay strong
Two decades one heart, now
everybody Sing!

Chorus Let's move as One Heart
With passion, trust and aspirations
Moving forward
2 decades, 3 and many more

Let's move as One Heart
With passion, trust and aspirations
Moving forward
2 decades, 3 and many more
2 decades, 3 and many more

