



Building a Community of Care





HealthCity
NOVENA

Building a Community of Care



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TTSH CELEBRATES
175 YEARS OF
CARE



Building a Community of Care

HealthCity Novena is about building a community of care. It aspires to be an 'open campus' that resembles a 'hub-and-spoke' to support the biggest population in Singapore — the central zone. As HealthCity belongs to everyone — patients, staff, visitors, students, partners and residents — every effort since its inception has been channelled to build as many connectors as possible to connect with the community and the central zone.

"We exist to serve and maintain the vibrancy of the people around us, to retain their hopes and aspirations for all stages of their lives, to aspire to greater meaning, purpose, and peace of mind in their life-journeys. These lofty ideals for Community provide the basis and justification for HealthCity Novena's mission," remarks Associate Professor Thomas Lew, Chairman, Tan Tock Seng Hospital (TTSH) Medical Board (February 2011 - April 2019) ■

(Below) Map showing Singapore's central zone (in white shade) where 1.4 million residents live, and where HealthCity Novena aspires to serve.



“Caring for our Community is the bedrock upon which we build HealthCity Novena. Truly, we want to make our HealthCity a special place where Health and Care are central to the population we serve. It is about our people caring as a community with our community.”

DR EUGENE FIDELIS SOH
Chief Executive Officer
TTSH and Central Health

“Tan Tock Seng’s compassion for the weak and needy must constantly serve as a reminder to do our utmost to care for each other.”

GAN KIM YONG
Minister for Health

Foreword

The Community of Care Continues

In 1819, a young enterprising 21-year-old, Tan Tock Seng, set foot on Singapore. Through hard work and thrift, he became a successful businessman. He subsequently founded Tan Tock Seng Hospital (TTSH) in 1844, then named the Chinese Pauper Hospital, to care for the sick in the community.

I am pleased to see TTSH together with its partners in the Novena community evolve into a major healthcare hub today, strengthening the way we deliver integrated care and promote good health for residents in the central region of Singapore. The 17-hectare HealthCity Novena, jointly developed by the Ministry of Health (MOH) and the National Healthcare Group (NHG), is a key initiative to develop medical excellence and provide affordable, accessible and quality care to Singaporeans. HealthCity Novena brings together 10 healthcare institution partners to develop a community of care, where healthcare, medical education and

translational research co-exist and thrive in an open and vibrant environment. I would like to extend my heartiest congratulations to the leadership and everyone involved in the HealthCity project.

Looking ahead, I believe HealthCity Novena will be the catalyst of many innovative healthcare projects as staff from TTSH and its many partners come together to evolve a model of care that goes beyond the hospital and into the community where the residents live, work and play.

Finally, as TTSH, ‘Our People’s Hospital’, celebrates its 175th Founder’s Day on 25 July 2019, I stand with every patient, staff, visitor, student, researcher, resident and partner to remember the rich legacy Tan Tock Seng has built. His compassion for the weak and needy must constantly serve as a reminder to do our utmost to care for each other.

GAN KIM YONG
Minister for Health
July 2019



(Main) Three new completed buildings now sit proudly beside TTSH Main Building as part of the developing HealthCity.
(Top to bottom left and right) TTSH in 1957; TTSH wards and Staff Recreational Centre in the 1950s.



Unfolding HealthCity Novena

The unfolding of HealthCity Novena Master Plan 2030 marks the vision, passion and care behind the landmark project to bring quality, affordable and accessible healthcare to the community. First conceptualised in 2009 in consultation with stakeholders in the community, HealthCity was unveiled in 2013 by Health Minister Gan Kim Yong. The Master Plan boasts a 17-hectare integrated healthcare development, and is scheduled to be completed in two phases by 2030, with the first phase slated to be completed in 2022. HealthCity will incorporate myriad vibrant and outstanding features, where care and community take centre stage. It will encompass a complete and holistic eco-system that includes health services, research and education, commercial, leisure and public spaces.

This HealthCity commemorative book, focuses on the three completed buildings: CHI, NCID and LKCMedicine CSB ■

“HealthCity Novena started off as an idea, became a vision and today, it’s a reality. This transformative journey is attributed to the collective passion and efforts of myriad stakeholders. Notwithstanding, the measure of HealthCity’s success lies not in the bricks and mortars per se, but in how it enables us to deliver better care for our patients and a better environment for staff, visitors and the community.”

STEPHEN LOH
Chief Development Officer
TTSH

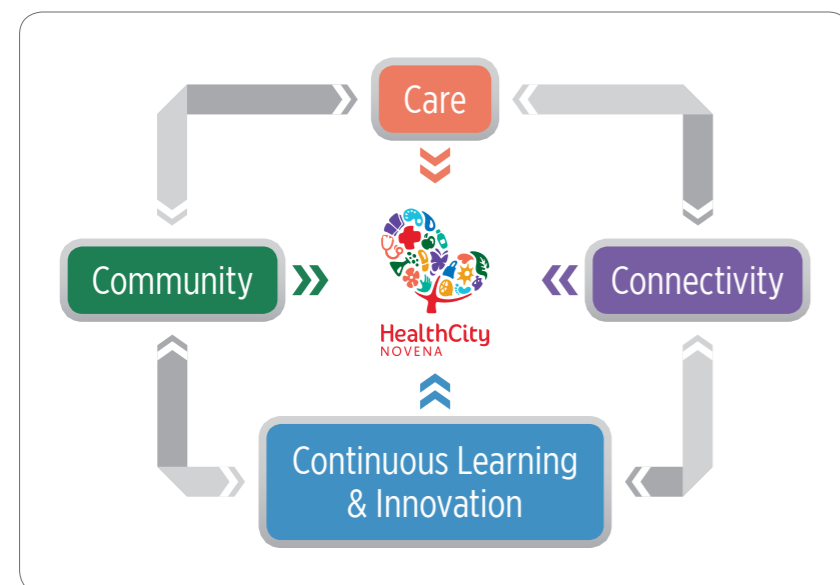


The HealthCity logo features a heart-shaped tree that represents vitality, energy and life that the campus aims to bring to the community; the 19 icons symbolises the different facets of HealthCity - that it is more than just a place to heal; and the multiple colours showcase HealthCity as an interlinked development of expert capabilities for holistic healthcare.

(Main) Rendering of the HealthCity Novena Master Plan 2030.

Nurturing Relationships with the Community

HealthCity seeks to create a community of healthcare, education and translational research in a vibrant and communal environment. That means nurturing a 'Novena community' where relationships can thrive. To help bring our vision of a patient-centred, community-based healthcare development to life, four key elements have been placed at the heart of the HealthCity planning process: *Care, Community, Connectivity* and *Continuous Learning & Innovation*. We are committed to: forging community partnerships; building connections to every node and corner of the community precinct, such as buildings, linkways, common paths, green spaces, etc; upholding teaching excellence; and redesigning care. Together, we hope all of this will bring about authentic and value-driven care to the community ■



(Above) A graphical presentation of how the 4C-approach helps to build a community of care.



“Nice hardware has to be complemented with good software. Beyond the beautiful and inspiring structures, it's imperative to strengthen the capabilities of the staff and implement initiatives to promote camaraderie and build a conducive working environment.”

JACLYN TAN
Senior Physiotherapist
TTSH



Photo courtesy of Surbana Jurong Consultants Pte Ltd



Fostering Connectivity + Openness Connected to Care

The concept of 'connectivity' features prominently in the HealthCity Novena Master Plan 2030. We believe that only care delivered through a connected community can last. Thus, via a vast network of creatively planned and interlinked via skybridges, pedestrian-friendly connections, service underpass and underground car parks, patients,

staff, visitors, students, partners and residents are able to move from one place to the next with ease and comfort. At the same time, HealthCity planners take great effort to ensure the campus has bountiful green spaces, character areas, invigorating landscaping and trails that foster a sense of community and openness to enliven life ■



(Main) Aerial shot of HealthCity Novena today.
(Top and bottom left, right) Lush green spaces within the HealthCity campus; HealthCity Link connects TTSH Main Building to NCID, CHI and our residents in Novena.

HealthCity Novena Master Plan 2013 to 2030

2009

HealthCity Novena
Master Plan 2030
Inception

Ng Teng Fong Centre for Healthcare
Innovation and National Centre for
Infectious Diseases Completed

2018



2025-2029



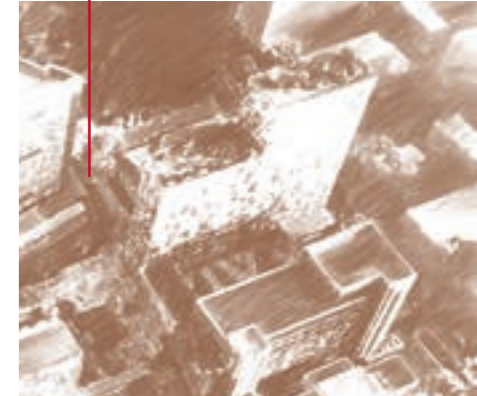
Ambulatory Expansion
and Clinical Staff Office



Central Park

2030

Health Sciences School



PHASE 1

2013

2016

2018

2021

2022

PHASE 2

2023

2026

2028

2030

Unveiling of HealthCity
Novena Master Plan
2030 by Health Minister
Gan Kim Yong

2013



Lee Kong Chian School of Medicine
Clinical Sciences Building Completed

2016



TTSH Integrated Care Hub
(construction in progress)

2021

2022



National Skin Centre and National Healthcare Group
(construction in progress)



National Centre/Reserve Site for Future Expansion

2030

Integrated Space Think Urban Design

Completed in 2018 under the HealthCity Novena Master Plan 2030 Phase 1, the newly opened CHI and NCID are situated at the north of the new development cluster. Based on specific urban design considerations, CHI and NCID are virtually in the heart of HealthCity, featuring a wide network of open spaces, pedestrian boulevard and vehicular access — all of which are intended to forge community bonding in the Novena neighbourhood. The plot is also connected to the TTSH Main Building and the adjacent LKCMedicine CSB. The motivation behind the 'Think Urban Design' concept is to create spaces that are open yet integrated ■

“One key operating principle behind operationalising HealthCity is that we'll run this as an integrated campus and not a collection of disparate entities. We'll harness the benefits of an integrated campus to provide a high level of operational efficiency and productivity.”

DR JAMIE MERVYN LIM
Chief Operating Officer
TTSH

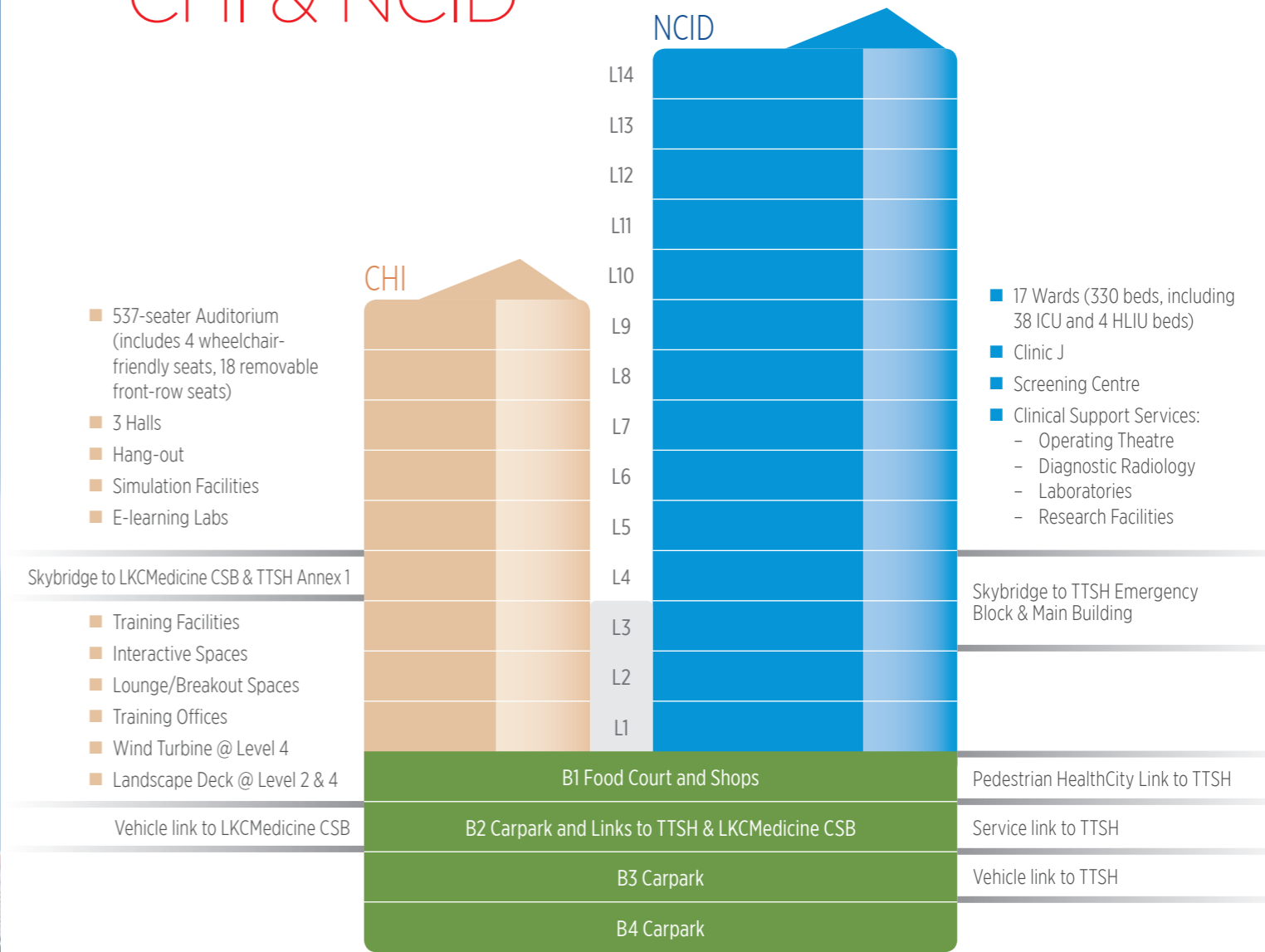


(Main) The intentional 'urban design thinking' behind integrating CHI and NCID to maximise its connectivity to TTSH Main Building and LKCMedicine CSB. (Bottom left to right) Map showing the centrality of CHI and NCID location in HealthCity; open spaces such as the Level 2 deck landscape adjoining CHI and NCID.

(Left and right) the 2-storey skybridge linking NCID and TTSH Emergency Block; another angle of CHI and NCID, with a skybridge linking LKCMedicine CSB.



Getting to Know CHI & NCID



Number of Storeys (CHI)
9+4 Basements

Number of Storeys (NCID)
14+4 Basements

Combined Plot Ratio
5.4

Gross Floor Area
106,523m²
20,876m² (CHI) + 85,647m² (NCID)

Carpark Lots
889

Combined Land Area
1.97
Hectare

“Beyond the modern metropolis and well-designed physical infrastructure that we all marvel at, HealthCity embodies at a deeper level: the long-held care philosophy at TTSH that tomorrow’s healthcare needs to be interconnected and integrated, comprehensive and holistic, patient-centric and relationship-based. In addition to supporting care excellence with relevant research and innovation, training and education, HealthCity also serves as the epicentre of TTSH and Central Health’s population health strategy, extending healthcare beyond the hospital to central Singapore, and ultimately moving beyond healthcare to health for the population. To the TTSH family, HealthCity symbolises the place where our collective professional aspirations and commitment to cure is rewarded with an irreplaceable sense of belonging, joy and fulfilment.”

ASSOC PROF CHIN JING JIH
Chairman, Medical Board
TTSH



(Main, bottom left to right) The skybridge linking CHI and LKCMedicine CSB; the landscape deck that connects CHI (right) and NCID (left); the 2-storey skybridge linking NCID and TTSH Main Building; inside the skybridge linking CHI and LKCMedicine CSB.

Practice, Innovation + Learning

A key consideration of the HealthCity Novena Master Plan 2030 is to achieve a high degree of ‘connectivity’ between its various infrastructural developments. How NCID, CHI and LKCMedicine CSB are linked is no exception. Beyond their physical integration, NCID’s provision of

clinical services and enhanced infrastructure, combined with CHI’s co-learning network and driven culture of innovation, and LKCMedicine’s teaching excellence, collectively contribute to a seamless workflow of learning, clinical excellence and handling of outbreaks ■

Redesigning Care.
Inspiring Learning



Ng Teng Fong Centre for Healthcare Innovation

With a fast-changing health landscape — evolving epidemiology of diseases, ageing population, workforce challenges, etc. — it's time to consider a 'care model' that lasts, and a motivated workforce that keeps learning. The new CHI hopes to achieve this twin purpose: to transform our healthcare workforce to better drive and deliver new care models for the future. It is a place where people gather to 'learn to care better together' through interactive learning, teaching and research opportunities. The 9-storey purpose-built conference, learning and innovation hub features events and learning facilities, simulation and innovation labs and engagement spaces, all of which are dedicated to spurring co-learning and collaboration ■

(Main) CHI today (below) CHI during the construction phase.



“ We envision a future workforce that is trans-professional and team-based, with skills to co-learn, un-learn and re-learn to continuously improve and innovate care — all of which centred on what people value. ”

DAVID DHEVARAJULU
Executive Director
CHI



3 Strategic Thrusts Driving Innovation

The drive to innovate — to redesign care and deliver value-based care — requires a mindset of learning, co-learning and co-innovating with partners and community engagement. That is why CHI embraces three strategic thrusts to reinforce its conceptualisation of its various spaces: *first*, build thought leadership in healthcare; *second*, drive workforce transformation; *third*, enable healthcare training through new teaching methods.

In his speech at a Town Hall meeting held at CHI on 19 November 2018, Dr Eugene Fidelis Soh, CEO of TTSH and Central Health, encouraged the staff, “Innovation must be our bridge between learning and doing, so that we can transform healthcare for the future. This bridge must be open to co-learning with local and overseas partners from healthcare, academia, agencies, industry and our community; it drives the re-design of care, the use of new technologies and the transformation of our workforce.” The following pages unfold what each space aims to achieve: learning, innovation and community enabling ■



Learning Auditorium

Inspired by the Greek amphitheatre, the 537-seat auditorium is the main space for large-scale co-learning events, such as conferences and masterclasses. It is designed without a stage — closing the space between the presenter and audience — and a tiered, curved seating that allows the audience to see each other, creating an

atmosphere of engagement, vibrant exchanges and conversation. The auditorium includes four wheelchair-friendly seats and 18 removable seats, and is equipped with three projectors forming a wide screen with live streaming capabilities to extend learning beyond the auditorium ■



(Main) Panoramic view of the auditorium.
(Top to bottom) Auditorium under construction;
near completion; in full session.



(Main) Panoramic view of the three Halls. (Bottom left to right) Hall under construction; a forum session; landscaped terrace adjacent to the Hall.

Hall

The three Halls at Level 2 are highly versatile. They can be configured to suit different event needs, such as conferences, workshops, exhibitions, retreats, event receptions and more. The three halls can also be opened up into one large space, spilling out into a landscaped terrace, which can be used as a breakout space.

David Dhevarajulu, Executive Director of CHI, highlights, “The physical layout of CHI was carefully thought out to engage innovators, staff, patients and the community to come together to have dialogues, innovation challenges and pitch for grants to spur the spirit of innovation.” ■



Harvard Room + Learning Studios

The Harvard Room at Level 6 derives its inspiration from seminar rooms in Harvard University. It has a tiered horseshoe design with attendees facing a central space for the presenter, which increases their interaction. Spread over Level 2 to 8, there are Learning Studios built for seminars, workshops and tutorials. Together, these spaces aim to leverage on co-learning, co-creating and collaborating, celebrating the 'Share-Learn-Do' and 'Do-Learn-Share' concept ■



(Main) A tiered horseshoe-designed Harvard Room.
(Bottom left and right) A configurable learning studio; seminar room with modular furniture offering a wide variety of configurations ranging from theatre, lecture and classroom to tutorial layout.



SIMTAC

Simulation and Integrated Medical Training Advancement Centre (SIMTAC) at Level 8 serves as a space to leverage simulation practice and technology to train interdisciplinary teams. It promotes, facilitates and supports Simulation-Based Healthcare Education (SBHE) programmes within the NHG. It comprises clinical spaces and rooms for simulation training such as: Emergency Resuscitation Intensive Unit, Operating Theatre, Ward, Consultation Room, Mock Home and Mock Pharmacy.

These spaces are designed to resemble the facilities at TTSH and the NCID for realistic simulation training. Other spaces are also provided in NCID for clinical training — such as the use of the third cluster of consultation rooms in Clinic J ■



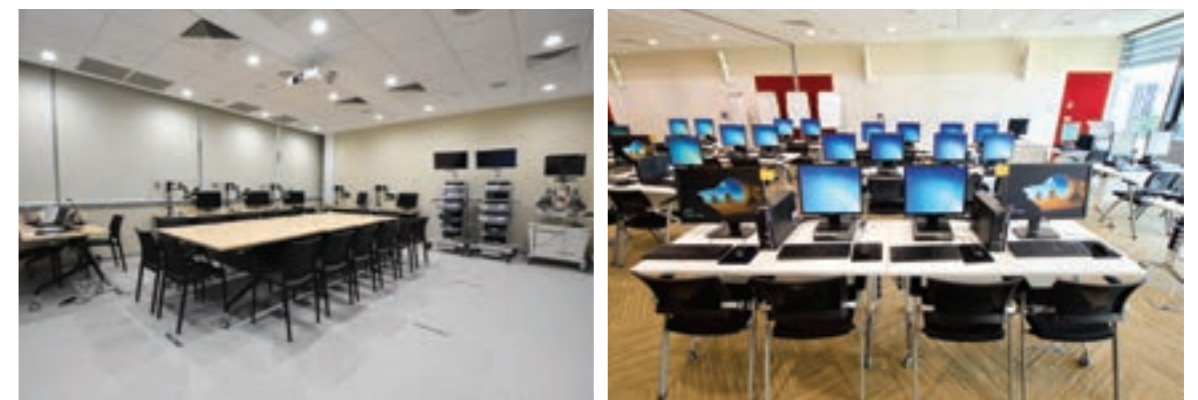
(Main, bottom left and right) Simulation of emergency resuscitation; SIMTAC entrance; Mock Home.

(Left and right) Control Room for trainers and Simulation Operating Theatre.



Skills Labs + E-Lab

The Skills Labs at Level 7 provide spaces and facilities where healthcare professionals sharpen their clinical knowledge and skills to care for patients. There are three Skills Labs equipped with medical gas points and interactive and dedicated facilities to train basic to advance clinical skills. E-labs give learners the flexibility to enhance their learning through various modes ■



(Main, bottom left and right) Skills Lab, Ortho Skills Lab training room and e-Lab.

Innovation Innocanvas

Innocanvas is a living canvas which showcases a range of hospital-based and community-based innovations in TTSH as well as from CHI and Central Health partners. It invites the visitors to walk in the footsteps of the patients' care journey from hospital to home. Through this journey, visitors will also see how Central Health works as an Integrated Model of Care and building health together with Central Health partners to serve the population in central Singapore. With Central Zone being the oldest part of Singapore population, it creates an opportunity for Central Health to redesign care and integrate technology with partners that will help to prepare Central Health to manage Singapore's future aged population. Innocanvas is also used as an engagement platform to bring staff from various functional groups, community and industry partners to co-create and redesign healthcare ■

(Below) Users walking through a stretch of Innocanvas where an eclectic array of ideas is exhibited to spur healthcare innovation.



(Top) Staff from different departments coming together to brainstorm ideas at Innospace.

Innospace

Another CHI 'innovation space' is the Innospace. It encourages staff to try out different configurations of medical spaces and design the most optimal space for clinical treatments. It can be divided into five rooms or used as one big hall to design and test the different flows in an improved end-to-end process. The ceiling and floor vinyl are designed in 500mm grid to aid users in visualising the dimensions of the space. The space is also equipped to facilitate the design and modelling of infrastructure employing, for example, CHI's unique Production and Process Preparation (3P) methodology, Value Stream Mapping and Clinical Practice Improvement Programme (CPIP) ■

“Creativity is a natural part of human thinking and behaviour. Realise the creative spark in you with CHILL and find innovative solutions to improve care for our patients.”

LYNETTE ONG
Director, Kaizen
Associate Director, CHI



CHI Living Lab (CHILL)

Situated at Level 1, CHILL is a maker space made easily accessible for staff, patients, caregivers and community partners to co-create and prototype ideas. Working in synergy with other innovation CHI spaces such as Innospace and Innocanvas, the Living Lab boasts workshop and open concept spaces with operable glass panels to showcase on-going activities to promote and test ideas to improve patient care and facilitate the expansion of the space for design and prototyping workshops as well as clinics ■



(Main) Prototyping Basics workshop series at the Living Lab.
(Bottom left to right) A prototype of multifunctional ward chair; learning through 'Hack-A-Thon' organised in March 2017; exterior view of CHILL.



Community Enabling Lounge@CHI + Co-Creation

Spaces at CHI are designed and interspersed between floors and locations, where users mingle to ideate innovation initiatives and build relationships. These are essential for collaboration and co-creation. The open concept of Lounge@CHI and co-creation spaces at Level 9 serves to promote this purpose. It features multi-use spaces such as open pantry, discussion corners, casual work spaces and hot desks for staff from different parts of the campus ■



(Main) Lounge@CHI gathers staff from various HealthCity buildings and departments to chat and relax. (Bottom left and right) Executives discussing ideas around a long table made from re-purposed trees and staff taking a break from their duties.

Landing Pad + Learners' Lounge

The Landing Pad (below) at Level 8, descending from the Lounge@CHI on Level 9, serves as an 'ideation space' to gather users to engage, discuss ideas and learn.

The Learners' Lounge (right) at Level 6 is another vibrant open concept space designed to bring about learning, collaboration and ideation from different stakeholders — to imagine new ways of workforce transformation ■



(Main) Staff taking time to explore ideas at the Learners' Lounge while (right) executives gather at the Landing Pad to converse and connect with each other.



Kampung Square Hangout + Cafe

Kampung Square is a bustling space that brings people together. It is where clinicians, learners, innovators, students, partners and volunteers meet for conversations over a good cup of coffee. Located at Level 4 and adjacent to the Hangout and Cafe, Kampung Square is designed as a natural extension of the auditorium to encourage continued dialogues ■

(Main, top to bottom) Overview of Kampung Square; a prominent video wall in Kampung Square, used to screen live events taking place in the Auditorium; Hangout where reference materials and games can be found; and a cafe.





MARKETPLACE

Marketplace

The Marketplace at Level 2 is another versatile space for connection and the exchange of ideas. The space is intended for the creation of collaboration opportunities for research and inspiration between providers and seekers. ■



Change Our Future! CHI Official Opening

CHI was officially opened on 9 May 2019 by Mr Gan Kim Yong, Minister for Health, in conjunction with CHI Innovate 2019, an annual healthcare conference organised by CHI. Themed 'Change Our Future!' and held from 9 to 10 May, the 2019 edition brought together over 800 top healthcare and innovation experts from around the world, partners including local and international healthcare innovation centres, strategic agencies, academia, industry and

community, plus NHG staff, to celebrate co-learning and collaboration in healthcare innovation and workforce transformation. In his speech, Mr Gan exhorted, "With rising healthcare demands from an ageing population and slowing local workforce growth, we need to innovate and transform our system to overcome constraints and seek new solutions. I hope to see CHI play a pivotal role in promoting innovation in healthcare." ■

(Main) Mr Gan (centre) set a butterfly kite off, signifying the metamorphosis of healthcare and innovation taking flight in the winds of change. Accompanying him in the front row were (on his immediate right) Mdm Kay Kuok, Chairman, NHG Board of Directors and Assoc Prof Kenneth Mak, Deputy Director, Medical Services (Health Services Group), MOH and (on his immediate left) Mr Philip Ng, CEO, Far East Organisation and Dr Benjamin Koh, Deputy Secretary (Development), MOH. (Top to bottom) Mr Gan being briefed at TTSH Operations Command Centre which uses the C3 system as the 'brain' of the hospital optimises patient flow and resource management to provide better care for patients; Mr Gan at CHI Living Lab, a maker-space that allows healthcare professionals to turn ideas into real-world solutions; sharing of Central Health cartoon with Mr Gan.

“Ultimately, we want our audience to ‘get woke’ about changing the way we work, learn, engage and lead in healthcare and in health.”

ASSOC PROF WONG HON TYM
Clinical Director, CHI



Special Feature Re-purposing Trees

Trees signify legacy and heritage. There was a conscientious effort to eventually feature them, as five trees, consisting of Sea Almond, Yellow Flame and Rain Tree, fell and were cut into logs to give way to the development of CHI and the NCID. They have since been re-purposed to make beautiful furniture such as benches and feature wall ■

(Main) Timber log sections Feature Wall at CHI, Level 1 shuttle bus pick-up point.
(Top to bottom) Elegant benches made of recycled logs now sitting elegantly at LKCMedicine Medical Library;
a bench made with repurposed trees at CHI Kampung Square; cut logs being treated and recycled.



Special Story

Ground Anchors

The construction of CHI and the NCID was not without challenge. One of the most formidable occurred when not one but four layers of ground anchors were discovered along the basement wall facing Jalan Tan Tock Seng to be in the way! Ground anchor is a device designed to support structures, most commonly used in geotechnical and construction applications. The 150mm diameter ground anchor consists of nine strands of steel tendons, connected to a bearing plate often used for the stabilisation of steep slopes or slopes consisting of softer soils, as well as the enhancement

of embankment or foundation soil capacity to prevent excessive erosion and landslides. Deep excavation pits were formed for investigation of the ground anchor shown in the photos. The purpose of investigation was to verify whether the ground anchors were still 'live' and accurate to the as-built drawing for Vehicle Underpass design. The investigation work was done carefully to avoid any dislodging of the ground anchor. Finally the Vehicle Underpass was diverted to the current state to avoid the area with extensive ground anchors ■



(Main, top to bottom) Great care is taken to ensure that the concrete wall for the investigation shaft does not affect the ground anchors; view of ground anchor from bottom; worker carefully exposing the ground anchor for investigation; each ground anchor's diameter is 150mm.

Special Feature Innovation at Play

The Innovation and Green Committee (IGC) has introduced a slew of lifestyle innovations to the landscape decks that connect CHI and NCID, as well as other spaces such as CHI Kampung Square and TTSH Main Building Level 4. The landscape decks at Level 2 and 4 feature relaxing gathering areas that bring people together to chat, chill and simply enjoy the great outdoors. CHI Level 4 Landscape Deck is also home to the wind turbine, which showcases the possibility of harnessing wind energy to power existing lights,

and solar tiles which use solar power absorbed in the day to provide lights to the deck at night. CHI Level 2 Landscape Deck spotlights a solar umbrella that harvests rain water and solar energy, and at the same time provides shelter to the public. TTSH Main Building Level 4 Landscape Deck sits a solar pergola that provides resting spaces as well as produces renewable energy. All these green features that have been integrated in the HealthCity not only reduce carbon footprint but also add vibrancy to the spaces ■

(Main) Wind turbine at CHI Level 4 Landscape Deck. (1st row, bottom left to right) Repurposed wood partner's wall and moss wall at CHI Level 1; solar-powered bladeless fan at Level 4 skybridge connecting CHI to TTSH Annex 1; solar umbrella at CHI Level 2 Landscape Deck. (2nd row, left to right) Moss wall at HealthCity Link; solar pergola at TTSH Main Building Level 4; energy-generating bicycle at CHI Kampung Square Level 4.



Connecting Care Frontiers

CHI and NCID share more than just a three-storey podium and four levels of basement. They share a common quest to explore new care frontiers: from thought leadership and innovation on care delivery model to implementation of clinical practice and processes and public health management. The two entities are inextricably intertwined to serve and support one another ■

“The meeting of healthcare function and form creates an architectural expression that is deserving of its presence in time of needs, and at same time, pleasurable to the beholders.”

CHAN CHEE CHUEN
Director, Development Office
TTSH



Managing Outbreaks.
Protecting Singapore



National Centre for Infectious Diseases

Singapore's capabilities in infectious disease prevention and management have been strengthened with the set-up of the new NCID. A 14-storey purpose-built facility, NCID features 17 wards and 330 inpatient beds (including 38 Intensive Care Unit [ICU] and 4 High Level Isolation Unit [HLIU] beds). It takes over the clinical functions of the Communicable Disease Centre (CDC). Like no other, NCID is a unique institution that brings under one roof public health, research, training and education, and community engagement functions to fulfil the mission of protecting the people of Singapore from infectious diseases. These include the National Public Health and Epidemiology Unit, the National Public Health Laboratory, the Infectious Disease Research and Training Office, the Antimicrobial Resistance Coordinating Office and National Public Health Programmes for Human Immunodeficiency Virus (HIV) and Tuberculosis. This integrated function places NCID in a better position and to be future-ready to cope with current and future challenges in infectious disease prevention and management. This section focuses on NCID's vital role, distinctive design principles, robust safety infrastructure and key features and functions ■

NCID has its roots in the Communicable Disease Centre (CDC). CDC was a century-old facility which served as the national referral centre for the clinical management of communicable diseases. Primarily, it was an isolation space for the containment of numerous outbreaks. CDC was in the spotlight when Singapore battled smallpox, plague, diphtheria, typhoid, cholera and malaria in the early 1900s, and SARS, H1N1 and Zika in the 21st century.

(Main) The new NCID, ready to respond to current and future challenges in infectious disease prevention and management. (Bottom left and right) CDC wards in the early 1900s and the entrance of the CDC.



“We see protecting people of Singapore from infectious diseases as our key responsibility. We have the clinical expertise as well as the infrastructure, processes and systems to be able to respond effectively to an outbreak.”

PROF LEO YEE SIN
Executive Director
NCID



Bridged for Integrated Care

The NCID works closely with TTSH to deliver quality patient care using a multidisciplinary approach, infrastructure and service-wise. To keep NCID facilities 'warm', i.e. in operation during a non-outbreak period, TTSH patients are admitted to three isolation wards at NCID, two operating theatres at NCID are used, and care is administered at the two ICU wards at NCID. NCID is linked with TTSH Emergency Block through the two-storey skybridge, pedestrian underpass link and service underpass link ■

(Main) Skybridge between NCID on the left and TTSH on the right.
(Top to bottom) Construction of the skybridge; completed skybridge; inside view of the skybridge, where staff cross at Level 2 and where patients are transferred between TTSH and NCID on Level 3.



“ NCID marks the next stage in evolution from the sprawling terrace wards of Middleton Hospital (1907-1984) and Communicable Diseases Centre (1985-2018) to today’s expansive 21st-century facility. They are each a testament of the Government’s commitment to effective infectious diseases management and outbreak control. I’m honoured to have witnessed this historic transition firsthand. ”

ASSOC PROF HSU LI YANG
Clinical Director
NCID

Keeping Vigilance

24/7 vigilance to fight outbreaks is the utmost priority of NCID. In the event of an outbreak, NCID’s advanced technology and modes of response come into play. These are described in the following pages. NCID’s prime concern is set on the safe treatment of patients, and safety of staff and the community. It has the clinical expertise and infrastructural capabilities to carry out this responsibility ■



NCID Design Principles

The NCID adopts a set of design principles that fuse *connectivity, convertibility, capability, safety, and capacity and scalability* to fulfil its mission of managing outbreaks. Its proximity to TTSH means it can tap on the resources of the acute hospital while remaining as a self-contained facility. It can also quickly convert existing spaces to accommodate sudden spikes in patient number during outbreak situation while reducing the risks of exposure to diseases and infection. Finally,

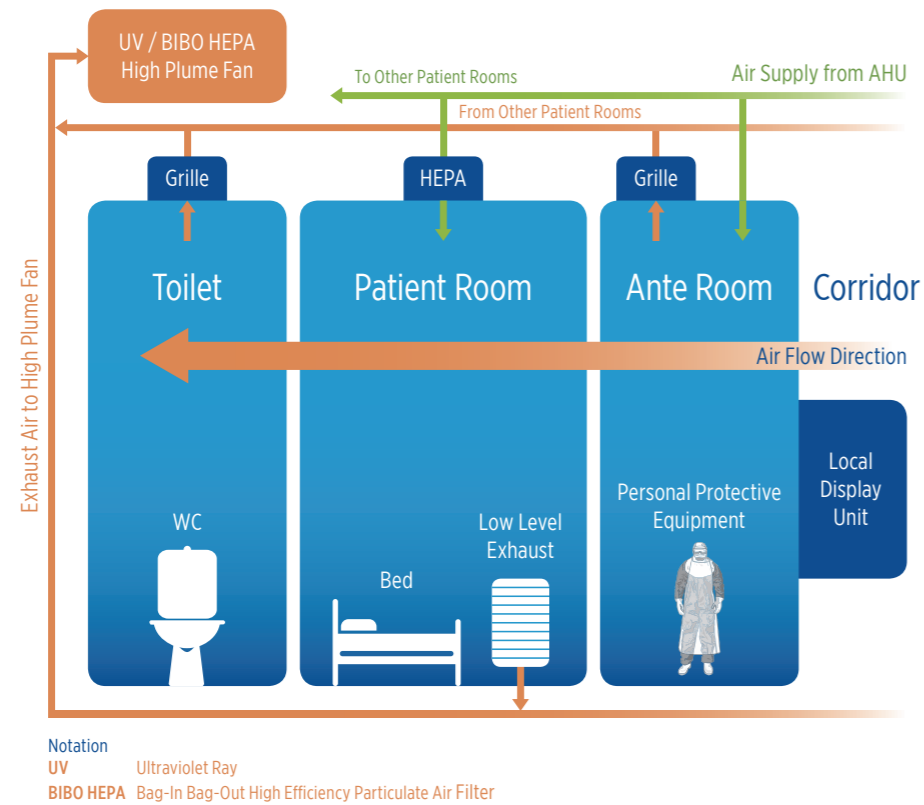
and most important of all, NCID has the capability to contain highly infectious viruses safely. It has the clinical know-how and infrastructural system to tackle diseases transmitted through various modes, including airborne, droplet and contact routes. These include the isolation, cohort and negative pressure (NEP) wards and the HLIU, self-contained lock-down ability, top-tier air filtration and airflow system and on-site laboratories ■

(Main) Mock exercise conducted at the HLIU. (Top to bottom) NCID has cohort, isolation and NEP wards as well as HLIU to cope with outbreaks, and every NEP isolation and cohort room is equipped with a hoist to transfer patients from bed to chair; the operating theatre is 'kept warm' during peacetime; training and outbreak drills being conducted at the Screening Centre.

Designing a Robust Airflow System

Ensuring safety at the NCID is paramount. One main challenge in designing NCID was the conceptualisation and installation of a robust airflow system. This is essential as any breach in airflow will render any response to outbreaks ineffective. Hence, first, there is a clear segregation of flows for patients, public, staff, clean and dirty materials. Second, for NCID wards, the airflow design is a single-pass air-conditioning system without recirculation, with separate air handling units (AHUs) supplying fresh air to different zones.

Its exhaust air passes through a top-tiered High Efficiency Particulate Air (HEPA) filter (99.999%) and is treated with ultraviolet ray (to eliminate any possible trace of microorganisms) before dispersing into the atmosphere with a high plume fan at the roof top. Besides, each room is designed with differential pressure to ensure air flows from a less negative to a more negative room. Every room had been tested for air tightness during the construction phase. This mitigates the possibility of air leakages ■



“Occupant Safety and environment protection is of the highest priority to NCID. That is why no efforts are spared in designing and maintaining the air-conditioning and mechanical ventilation system.”

ER GOH MIA SIANG, PE
 JCI Facilities Management and Safety Chapter Leader
 Director, Facilities Management Office



(Main) Schematics on how negative pressure is achieved in each room. (Above left and right) Engineers testing air tightness; airflow system during construction phase.



Safe Recuperation

With 'safety' as the top-of-mind consideration in every detail of the NCID infrastructural design and clinical operation, patients can assuredly recuperate in a protected and secure environment. In addition, given the international safety standards NCID relentlessly strives to meet and uphold, staff are enabled to confidently perform their tasks ■

(Main) A furnished isolation room with the panel board that features the various air filtration/flow systems.
(Bottom left to right) Stringent inspection by infection control reviewer on air integrity; air pipings under construction; and decontamination zones within HLIU, designed in accordance to international standards and local regulations for waste management protocols.



High Level Isolation Unit

HLIU is a purpose-built facility with the capability and flexibility to manage highly virulent infectious diseases safely, from viral haemorrhagic fevers such as Ebola, to bio-threats such as smallpox, or novel pathogens causing serious outbreaks. The bio-containment unit comprises four patient rooms with toilets and showers, a dedicated laboratory

for specimen processing, and self-contained decontamination facilities. The infrastructure and engineering systems are designed to enable safe handling and treatment of patients, with medical equipment to cater for diagnostic and surgical procedures, and next-of-kin communication provisions to enhance patient and staff safety ■



(Main) A HLIU room.
 (Right from top) Clean flow - staff donning room; doffing room with shower; dirty flow - utility room
 (Bottom left to right) Donning in process; pass-through hatch; safety signal lights.



Screening Centre

The Screening Centre facilitates mass screening in the event of an outbreak. It is designed with separate zones for low-risk and high-risk patients, where they are grouped before they are channelled to low-risk and high-risk areas for investigations such as vital signs, blood test, x-ray and consultations. There are isolation rooms within

the Screening Centre to hold patients before admission to the wards. The NCID Screening Centre is a response to the learning experience from the 2003 SARS epidemic, when TTSH had to use makeshift tents in the carpark to accommodate the screening of large numbers of patients ■



(Main and bottom left) Screening centre featuring different zones (coloured columns/walls) for patients with different risk levels.
(Bottom middle and right) Standby beds at the Screening Centre and Triage Counter.



(Main and bottom left) The new Clinic J at NCID; the previous Specialist Outpatient Clinic (SOC) J at the Communicable Disease Centre.
 (Bottom middle and right) Waiting area at Clinic J; and a consultation session conducted at Clinic J.

Clinic J

The NCID specialist outpatient Clinic J provides consultation to patients with proven or suspected infections. It serves as a one-stop solution for patients with chronic infectious conditions, providing multidisciplinary specialist care, counselling, pharmacy, radiology services. The Day Treatment Centre is an extension of Clinic J and offers services such as lumbar puncture, sputum induction, pentamidine puff, Papanicolaou (Pap) smear and ophthalmology ■



Ward Design

Beyond safety considerations, wards at the NCID are designed for efficiency and flexibility. The triangular ward layout configuration allows for better line-of-sight of patient room and better efficiency. It is also designed similar to TTSH wards so clinical staff are more familiar with the layout when they are deployed to the NCID wards during

outbreaks. Its interior design is functional, with accent colours of the nurse alcoves identifying the entrances of each room, with different colours used on different floors. Also, the ward design features a modular concept to enable future conversion of one type of ward into another with minimal renovations and without impact to the major structures ■



(Main, bottom left to right) Broad passageway between nurse station and wards to ease patient bed movement; nurses using mobile computer to access data on the go; nurse alcove to facilitate patient management; and a clear view of wards from the nurse station.



(Main) NPHL staff undergoing training to operate the Class III Biosafety Cabinet in Biosafety Level 3 (BSL-3) containment facility. (Top and bottom) A laboratory staff conducting a diagnostic test at DLM; IDRL staff conducting tests.

Laboratories

Three on-site laboratories have been distinctively set up within the NCID. The Department of Laboratory Medicine (DLM) is equipped to perform a wide range of diagnostic laboratory tests in a fast, consistent and reliable manner that aids the diagnosis and treatment of patients in NCID. The Infectious Disease Research Laboratory (IDRL) conducts research on infectious diseases in order to improve understanding of disease aetiologies

and disruption of disease. The National Public Health Laboratory (NPHL) supports the Ministry of Health in surveillance and outbreak investigation of infectious diseases. NPHL works with its partners from the medical laboratories and government agencies to enable a coordinated, timely and broad-based response to infectious threats of public health importance. Other important roles of NPHL are in pandemic preparedness and detection

of rare and exotic agents arising from natural transmission or malicious release. Prof Leo Yee Sin, Executive Director of NCID, remarks, "Integrating the clinical and public health units allows us to integrate evidence-based practices, surveillance and epidemiology analysis, continuous skill-based upgrading, cross fertilisation and seamless flow in implementation and programme evaluation." ■



Engaging the Community

NCID Cares

NCID Cares, known previously as Patient Care Centre (PCC), helps the marginalised community of patients living with HIV through different programmes, including the Nutritional Programme, Red Ribbon Project, medication/diagnostic subsidies and befriending and touch therapy services. In the near future, NCID Cares will also work towards public education via community

partnership and engagement to prevent the spread of infectious diseases and build community preparedness for outbreaks. Focus areas include awareness and knowledge about HIV to combat stigma and discrimination, vaccines to improve adoption of recommended adult vaccination, antibiotic resistance to reduce antibiotic overuse, and vector-borne infections such as dengue ■



(Main) During a typical befriending session at NCID Cares.
(Bottom left and right) Patient Volunteer engaging in making of handicraft under the Red Ribbon Project, a programme of NCID Cares; a warm and inviting space at NCID Cares.



Connecting Practice & Learning

The proximity of the NCID and LKCMedicine CSB to each other presents a rare opportunity to connect practice with learning. It enables clinicians and other specialist centres of TTSH to form close connections with LKCMedicine researchers, sowing the seeds for new collaborations in fields such as population health, diabetes, infectious diseases, skin diseases, and neuroscience and mental health. It also paves the way for world-class experts in engineering, nanotechnology and biological sciences to work together with the aim of improving the detection, prevention and management of illness ■

Lee Kong Chian School of Medicine Clinical Sciences Building Shaping Hearts. Nurturing Minds

The modern high-rise LKCMedicine CSB sits surrounded by the many healthcare institutions within HealthCity and serves to facilitate students' integration into clinical settings and promote collaborative learning and interaction between students and healthcare professionals ■

“Our mission is to nurture the kind of doctors who you and I would like to have caring for us . . . We want our ethos to reflect the values of the School: Humility, Integrity, Compassion, Continuous Learning, Unity and Professionalism — values that overlap significantly with the values of TTSH.”

PROF JAMES BEST
Dean
LKCMedicine

Re-imagining the Future of Learning

Opened in January 2017, the 20-storey LKCMedicine CSB houses state-of-the-art smart classrooms and medical teaching facilities such as the circular 250-seat Learning Studio which is custom-built to support the School's technology-enhanced Team-Based Learning approach. The Anatomy Learning Centre, which consists of a cluster of 11 alcoves distributed around a central teaching core; and the Centre for Clinical Simulation, which consists of a practical skills lab, simulated four-bed ward, and a communication suite with 10-paired consultation rooms, so that students can practise their skills in a realistic environment.

Besides being home to LKCMedicine researchers, with the laboratories interconnected through collaborative spaces, the CSB also hosts several world-class technology-enhanced research platforms and centres, including the Centre for Population Health Sciences, and the NHG Polyclinics-LKCMedicine joint Centre for Primary Health Care Research & Innovation. LKCMedicine is currently conducting a major, comprehensive population health study — the Health for Life in Singapore (HELIOS) study — in collaboration with Imperial College London and NHG ■

(Main, bottom left and right): Broad view of the 20-storey CSB; an aerial view of CSB in the Novena vicinity; LKCMedicine with its 1924-built heritage HQ and the adjacent NCID.





Heritage. Modernity

Combining heritage with modernity, the circular driveway at the CSB Plaza overlooks the restored heritage Headquarters Building, formerly the administrative building of the old Tan Tock Seng Building. This gives a sense of history, at the same time, a contemporary feel of the future of medicine ■



State-of-the-Art Learning Spaces

To facilitate and invigorate learning, world-class spaces adorn the entire LKCMedicine CSB. These include the 250-seat Learning Studio, where its circular shape can hold over 40 round tables at which students can work in groups of six. The Studio is fully technology-enabled and equipped with six large projector screens. Other spaces include the Ong Tiong Tat & Irene Tan Liang Kheng Auditorium, research labs and Anatomy Learning Centre ■

(Main, top to bottom) The 250-seat Learning Studio; the auditorium that seats 500; the gym on Level 8; and a research lab.

“ I enjoy having Team-Based Learning in the Learning Studio as it is spacious and constructive for discussion and teamwork. The surrounding view of Novena is also really nice to look at! ”

NICOLAS KHAIRUL BUREAU
Class of 2020
LKCMedicine

“Starting a new medical school gives us an opportunity to use new ways to teach, such as Team-Based Learning, and new tools for teaching, such as ultrasound; at the same time, it enhances the values that are important, including patient-centredness and integrity.”

ASSOC PROF THAM KUM YING
Education Director, TTSH and
Senior Consultant, Emergency Department, TTSH

“I'm glad to be learning how to treat patients using the latest medical equipment and advanced software available at the LKCMedicine CSB. All of these facilitate us to be more effective and confident in picking up new knowledge and skills.”

RUSSELL CHUAH
Class of 2019
LKCMedicine





The Medical Library

Crowning the CSB is the rooftop Medical Library which not only boasts an impressive collection of medical journals, textbooks and unique collections such as the Medical Art Print Collection, Children's Health Collection and Singapore (SG) Doctors, but also a panoramic view of Singapore's city skyline ■

Looking Ahead What's Next

Looking back at what has been achieved since the HealthCity Novena Master Plan 2030 was conceived in 2009, the project team is thankful for the completion of three of the Phase 1 developments: CHI, NCID and LKCMedicine CSB. Looking ahead, two remaining Phase 1 buildings will be added by 2022. They are the TTSH Integrated Care Hub (TTSH-ICH) and the new NSC, within which the NHG will be housed. This will be followed by Phase 2 development, which starts from 2023 and is slated to complete by 2030 ■



“ We built HealthCity because we felt it is important to look after the population we serve. Its function is for the population, our partners, patients, neighbours and not for ourselves. It is a place where healing and learning take place. ”

PROF PHILIP CHOO
Group CEO
NHG

(Main) Rendering of the HealthCity Novena Master Plan 2030. The names of building in yellow denote future infrastructural developments to be built.



(Main) View from Irrawaddy Road and Tan Tock Seng Link.
 (Top) Atrium at Level 1.
 (Middle) Concourse at Level 1.
 (Bottom) Dover Park Hospice at Level 1.

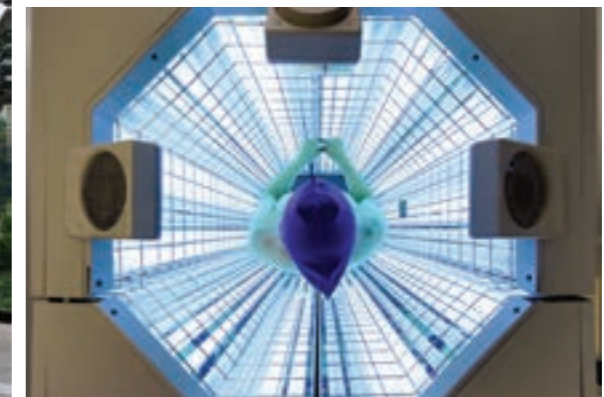
TTSH Integrated Care Hub

Integrated care is a holistic concept: it taps on ready resources in organisations to share the responsibilities of healthcare. TTSH-ICH focuses on the seamless continuum of care by bridging patients, from the acute care setting to step down facilities and eventually back to their homes and communities. TTSH-ICH is slated to open in 2021 and will be the rehabilitative pillar of HealthCity ■

Holistic Care All Under One Roof

A purpose-built new healthcare facility with more than 600 beds and a full range of rehabilitation care facilities, TTSH-ICH is intentionally located next to TTSH to facilitate seamless care and connectivity. Ren Ci Hospital (RCH) provides affordable medical, nursing and rehabilitative care services while adjacent Dover Park Hospice (DPH) specialises in end-of-life care and palliative care. When opened in 2021, TTSH-ICH will provide the crucial link between acute hospital and

community care, bringing together rehabilitation, sub-acute care and palliative care services under one roof. It will help to optimise patients' recovery and independence to prepare them to lead life back at home. Prof Philip Choo, Group CEO of NHG, recalls, "I was thinking: critical care hospital (like TTSH) should not be used for caring for chronic and palliative and end-of-life cases. The idea of TTSH-ICH was thus birthed — a bridge between acute care at TTSH-ICH and home." ■



A Bigger Home National Skin Centre

Beyond delivering quality dermatological care to the public, the new NSC, when completed in 2022, will focus on enhancing its research arm, expanding cohesive community care and engaging in community outreach. The centre will continue to develop key research and commit itself to attracting and nurturing promising clinicians ■

(Main, top to bottom) NSC Building; future NSC lobby; phototherapy treatment in progress; consultation in session.

A New Home National Healthcare Group

The corporate headquarters of the NHG will be housed within the new NSC premises ■





(Main) Artist's impression of the developing HealthCity campus (viewed from Southern Gateway), with the proposed Ambulatory Centre and Clinical Staff Office Building taking centrestage (the building on the left). (Top to bottom) Artist's impression of the proposed Health Sciences Building; the proposed National Centre; and Central Park.

HealthCity Novena Phase 2

As Phase 1 of the HealthCity Novena charts towards completion in 2022, Phase 2 is being planned in earnest, which is set to start in 2023 and end in 2030. It will see the installation of the expanded TTSH Ambulatory Centre & Clinical Staff Office and Health Sciences School, among other key proposed developments ■

“What is clear, as we reflect deeply on what the future holds for this gleaming city of steel, machines, and technology, amidst the deeper memories of terracotta roofs, grassy knolls and peeling paints from ancient wooden walls etched in the older legacy of Tan Tock Seng and its environs, is how dependent we are on the life-blood of the community around us.”

ASSOC PROF THOMAS LEW
Chairman, Medical Board
TTSH
(February 2011 – April 2019)

Voices of Staff I Say ...

“The new NCID is a great place to work in. I remember in the previous Communicable Disease Centre (CDC), at times we encountered floods but here (NCID), it's like a 'resort'! It's so new and well-equipped.”

JANAKI D/O KRISHNA
Clinic's Assistant Patient Service Attendant Supervisor, NCID

“I'm really happy that I can be part of the HealthCity family. I feel responsible to ensure every part of this new campus remains clean and ready for use. Together with my colleagues, we're committed to doing our very best.”

ALIBUYOG MARK HECTOR
Housecleaning Supervisor, NCID

“It's a real joy to call HealthCity my second home as I learn to work with my colleagues to find better ways to care for our patients. Also, I feel privileged to be part of this big family. I hope to learn and grow in my career as well as a person.”

NADIAH BTE NORASWAN
Staff Nurse, NCID

(Left to right) Nadiah Bte Noraswan, Alibuyog Mark Hector and Janaki D/o Krishna.





“ While we’ll miss the amazing times we had working together at the CDC, we’re excited to embrace the all-new challenges at NCID. The new facilities, technology and hi-tech equipment do motivate us to do well to care better for our patients. ”

BOO CHECK KIA | Assistant Nurse Clinician
CHUA TIOW SHEN | Senior Staff Nurse
HUMARIAH BTE TAJUDIN | Senior Assistant Nurse

(Left to right) Humariah Bte Tajudin, Chua Tiow Shen and Boo Check Kia.

“Facilities Engineering worked with a dedicated project team to identify and rectify relevant design/ installation issues. Going forward, we endeavour to keep mission-critical facilities, such as NCID, operation-ready at all times, via our planned maintenance programme.”

SHAHRL BIN ALIAS
Senior Technician, Facilities Engineering

“The satisfaction from this HealthCity journey derives from the end users and patients’ satisfaction with the new facilities and smooth workflows — a result of years of planning and hard work by multiple stakeholders to set up NCID and CHI. Thanks to all for the hard work!”

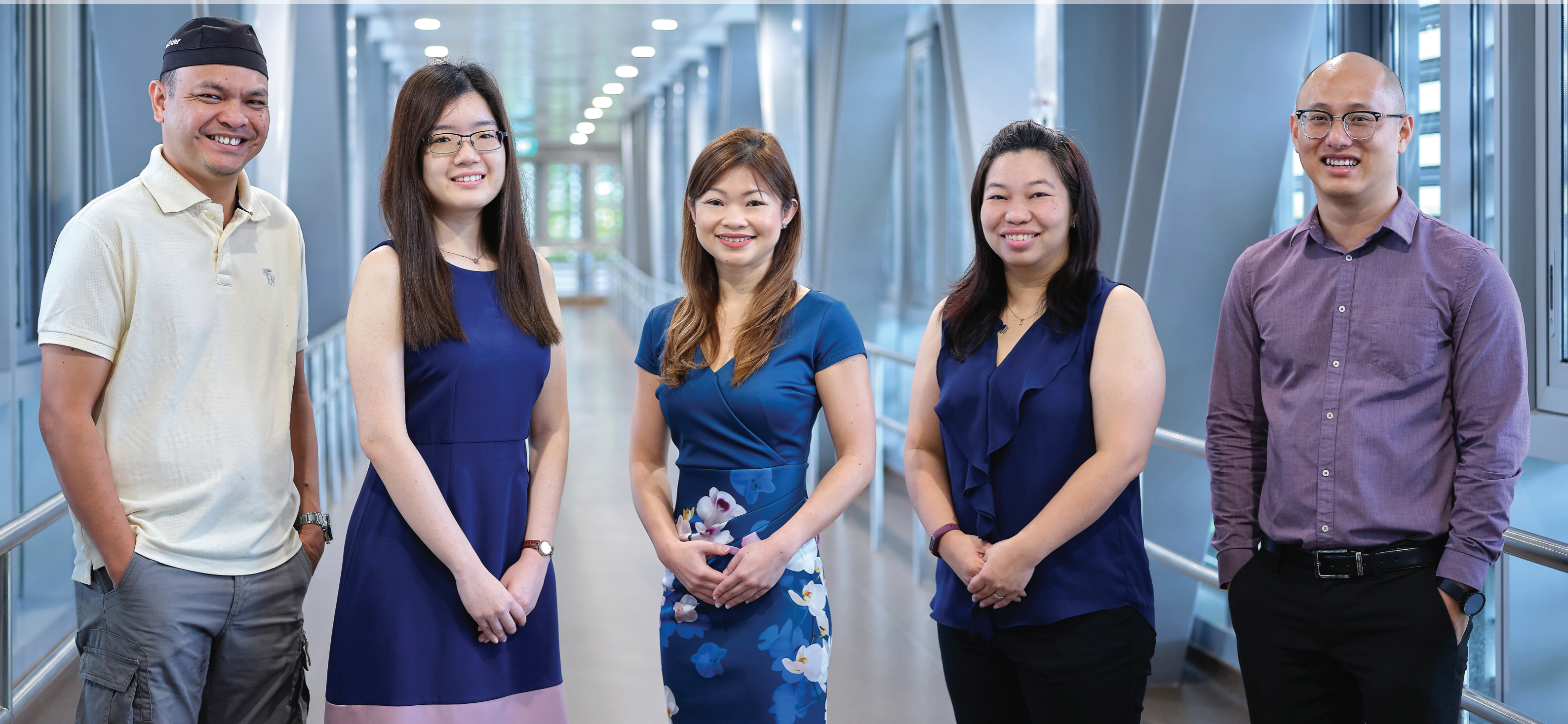
JASMINE TEO
Executive, NCID Operations

“CHI stands for ‘co-creation’. We aspire to build an enduring culture of innovation, learning and sharing, where users can freely exchange ideas and knowledge, leverage on past experiences and best practices in healthcare, and ultimately morph them into new and better ideas. It’s a hallmark we aim to uphold.”

MELANIE KAM | Dy Director, CHI
TAN SIAN LI | Manager, Kaizen, CHI

“Teamwork from the various parties — users, consultant, builder, etc. — is crucial for the smooth and timely completion the HealthCity project . . . the campus will deliver a better healthcare and learning environment.”

SEBASTIAN LOH
Engineer, NCID & CHI
Commissioning Secretariat (ComSec)



THE EDITORIAL TEAM

The editorial team members pen their thoughts on coming together to work on the developments and producing this commemorative HealthCity book.



“It takes a concerted effort to advance and explore opportunities for positive change in developing better facility and community ■ SANNY LEE, NCID & CHI ComSec

I hope this book preserves and captures this moment as we see it today and brings joy to all future readers ■ KEITH GOH, NCID & CHI ComSec

Our team is truly grateful to everyone who has contributed and shared invaluable inputs to help shape the book ■ JOCELYN YOW, NCID & CHI ComSec

Indeed, the experience and learning throughout the process of producing this book has been great; and the end result is equally great!

■ TIONG ZHONG HAN, NCID & CHI ComSec

Everyone contributes a ‘little’ to the successful development of the HealthCity and it is exactly this ‘little’ effort that adds up to bringing you to what you see now at the HealthCity Campus ■ LYNN WONG, TTSH-ICH ComSec

I hope that you will enjoy reading this book and be inspired by the unsung heroes and heroines behind the scenes ■ ERIKA HEW, TTSH-ICH ComSec

This book gives its reader an opportunity to view the evolution of HealthCity Novena through the lens of those who brought it about ■ ASHISH BANSAL, HealthCity Novena Master Planner”

“The transformation of space is evident through the hard work of many who choose to make a difference. Many did and this editorial team did so ever so sacrificially.”

CHAN CHEE CHUEN
Director, Development Office
TTSH



(From left to right, standing) Sanny Lee¹, Stephen Loh², Erika Hew³, Dr Eugene Fidelis Soh⁴, Chan Chee Chuen⁵

(From left to right, seated) Lynn Wong⁶, Tiong Zhong Han⁷, Keith Goh⁸, Ashish Bansal⁹, Jocelyn Yow¹⁰

(Not in the picture) Kong Suet Yuet and Sharon Tan Hwei Ching

ACKNOWLEDGEMENTS

This book is produced with the support of:

Ministry of Health
National Healthcare Group
Tan Tock Seng Hospital
National Centre for Infectious Diseases
Ng Teng Fong Centre for Healthcare Innovation
Lee Kong Chian School of Medicine
National Skin Centre
MOH Holdings Pte Ltd
CPG Consultants Pte Ltd
CIAP Architects Pte Ltd
Kajima Overseas Asia (Singapore) Pte Ltd
Surbana Jurong Consultants Pte Ltd

All TTSH colleagues who coordinated and participated in the photography shoot.

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Published by
HealthCity Novena
Development Office
Tan Tock Seng Hospital
Email: contact@ttsh.com.sg
www.ttsh.com.sg

Produced by Write Editions®
Email: publisher@writeeditions.com
writeeditions.com

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Creative Direction by Write Editions® | Photography by Alex Heng

Printed in Singapore

ISBN: 978-981-14-1435-0 (hardcover)
ISBN: 978-981-14-1436-7 (softcover)
ISBN: 978-981-14-1437-4 (ebook)

Download eBook via QR Code:



National Library Board, Singapore Cataloguing-in-Publication Data

Title: HealthCity Novena Building a Community of Care.
Other title(s): HealthCity Novena.
Description: Singapore : HealthCity Novena Development Office, Tan Tock Seng Hospital, [2019] | Produced by Write Editions.
Identifier(s): OCN 1099484662 | ISBN 978-981-14-1435-0 (hardcover) | ISBN 978-981-14-1436-7 (softcover) | ISBN 978-981-14-1437-4 (ebook)
Subject(s): LCSH: Integrated Delivery of Healthcare--Singapore. | Patient-centered Health Care--Singapore. | Health Facilities--Singapore. | Medical Care--Singapore. | Public Care--Singapore.
Classification: DDC 362.1095957--dc23



Building a Community of Care

The unfolding of the HealthCity Novena Master Plan 2030 marks the vision, passion and care behind the landmark project to bring quality, affordable and accessible healthcare to the community. First conceptualised in 2009 and unveiled in 2013, the Master Plan boasts a 17-hectare integrated healthcare development, and is scheduled to be completed in two phases by 2030, with the first phase slated to be completed in 2022. This HealthCity commemorative book focuses on the three completed buildings: Ng Teng Fong Centre for Healthcare Innovation, National Centre for Infectious Diseases and Lee Kong Chian School of Medicine Clinical Sciences Building ■



Healthcare/Reference/General
writeeditions.com

ISBN 978-981-14-1437-4



9 789811 414374

