



Welcome to  **Tan Tock Seng**
HOSPITAL

CELEBRATING 169 YEARS OF TRADITION AND TRANSFORMATION IN HEALTHCARE

RESEARCH

Our MISSION



- Building on our **tradition**
- Reaching out to the **community**
- Doing our best to **serve, care and heal**
- Together, we aim for excellence in **cost effective** healthcare, education and research

TTSH at a **GLANCE**

- **Established in 1844**
- **One of the largest multi-disciplinary hospitals in Singapore**
- **1,515 Operational Beds, 79 ICU & HD Beds**
- **>7,000 staff**
- **27 Clinical Disciplines**
- **Collaboration with world renowned cancer centre, Johns Hopkins – Singapore International Medical Centre**
- **Multiple Quality Awards winner**



A Day in TTSH (2012)



154 Admissions



2,371 SOC Attendances



- **443** ED Attendances
- **88** Ambulance Cases



270 Operations

- 29.5% Inpatients
- 70.5% Ambulatory
(Day Surgery)

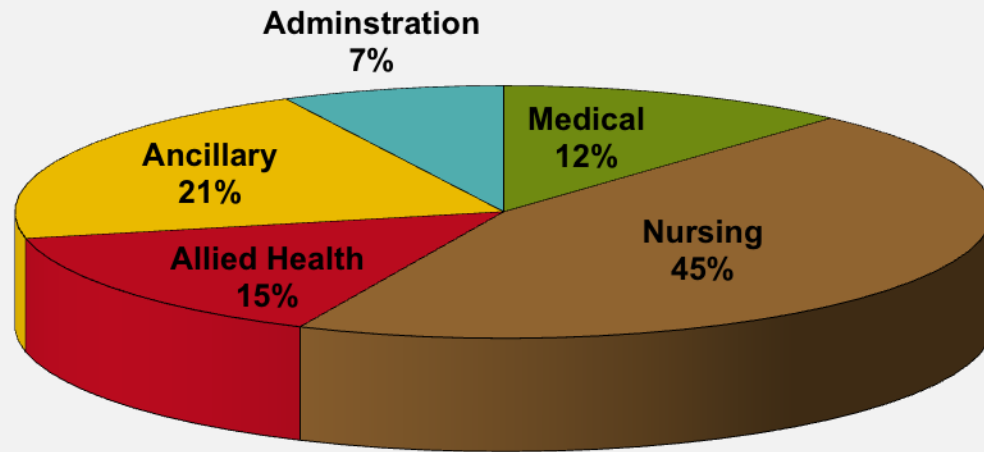


- **1,166** Radiological Investigations
- **12,800** Lab Tests



1,887 Therapy Attendances

Total Staff numbers (2012)



7,353

Traditional STRENGTHS – Clinical Care

GERIATRIC MEDICINE

- 1st Geriatric Unit in Singapore
- Multi Disciplinary approach in caring for the elderly
- Integrated Long term Care



INFECTIOUS DISEASE

- National role in formulating & implementing disease control
- National HIV management & drug protocol
- Designated centre for SARS, Avian Flu & H1N1
- Dengue Research



REHABILITATION MEDICINE

- Largest & comprehensive inpatient rehab services
- Neurorehab Facilities – Robotic gait training systems



Traditional STRENGTHS – Clinical Care

RESPIRATORY MEDICINE

- Comprehensive service for patients with airway & lung disorders
- National Tuberculosis Programme – STEP (Singapore TB Elimination Programme)



RHEUMATOLOGY, ALLERGY AND IMMUNOLOGY

- Largest in Singapore
- Major referral centre for patients with rheumatology & allergic disorders



EMERGENCY AND TRAUMA MEDICINE

- Second largest & one of the busiest
- Biggest Trauma centre in the region with training facilities

Traditional STRENGTHS – Clinical Care

ORTHOPAEDICS

OPHTHALMOLOGY

EAR, NOSE & THROAT

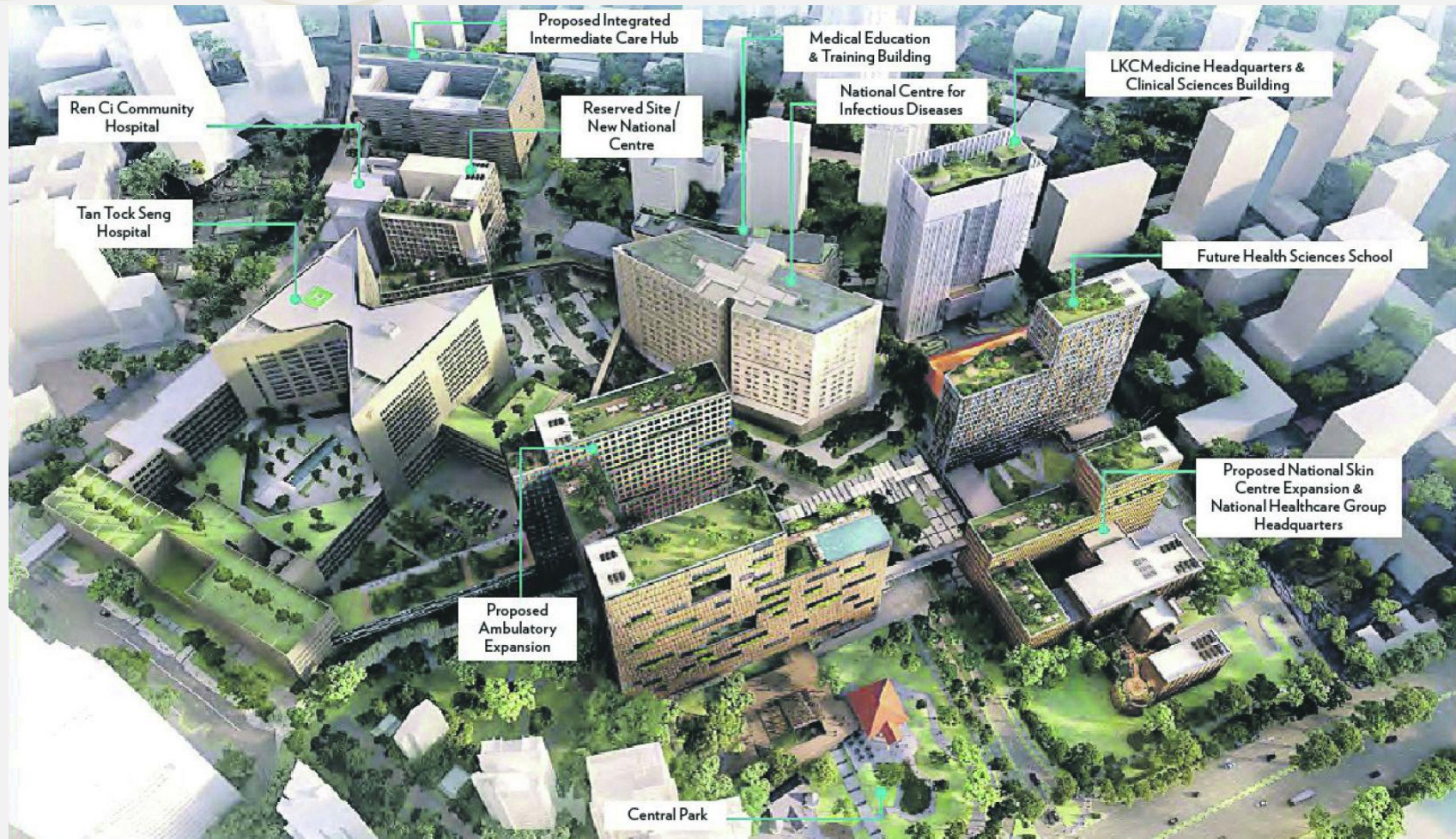
SURGICAL ONCOLOGY

**DESIGNATED CENTRES
AND COLLABORATIONS**

1. National Centre for Infectious Disease, Communicable Disease Centre (MOH)
2. National Tuberculosis Programme (MOH)
3. Medical Oncology (Johns Hopkins International Medical Centre)
4. Neurological Diseases (National Neuroscience Institute)
5. Institute of Geriatrics and Active Ageing
6. Step-down Care Partners (nursing homes, community hospitals)



Health City Novena



Building upon our strengths – Research in TTSH

- The strength of TTSH research lies in clinical research
- The *high patient load* provides a rich source of clinical research material
- Doctors and other staff are limited by time and space available for research, but *collaborations with partners* have ameliorated some of these problems
 - E.g. With Nanyang Technological University, Singapore (engineering in medicine, bioimaging, biological sciences, home healthcare)
- Ongoing clinical trials are mainly phase 3 and 4 trials
- Facility for phase 1 and 2 studies is ready

Building upon our strengths – Research in TTSH

Medical disciplines	Research interests
Infectious Disease/Microbiology	Influenza, dengue, HIV, antibiotic stewardship
Rehabilitation medicine	Robotics, outcomes of stroke rehab
Rheumatology, Allergy and Immunology	Systemic lupus erythematosus, rheumatoid arthritis
Respiratory Medicine	Tuberculosis
Ophthalmology	Macular generation, neovascularization
Diagnostic Radiology	MRI techniques and contrast media
Surgery	Urological, breast, liver and pancreatic malignancies
Geriatric Medicine	Dementia, community care
Nursing	Evidence-based nursing, re-thinking care delivery
Otorhinolaryngology	Reconstructive surgery
Endocrinology	Metabolic syndromes

Research Activities 2009-2012

	2009	2010	2011	2012
Successful grants	9	7	21	10
New sponsored clinical trials (ongoing)	29 (84)	10 (65)	14 (62)	19 (62)
Extramural Grant Monies	\$4,334,749	\$1,400,068	\$6,903,862	\$1,941,608
Publications	118	110	316	315

Brain Computer Interface Therapy

- EEG (thought-based) sensitive robotic therapy
- Collaboration with the National Neuroscience Institute and the Agency for Science, Technology and Research (A*STAR)
- Faster recovery in limb movements in stroke patients

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features

Move my arm, robot

Thought-based robot therapy helps stroke patients recover. Chan Chi-Loong reports

DOCTORS at Tan Tock Seng Hospital (TSH) have quietly scored a world first for using thought-based robot therapy to help stroke patients recover.

Their work on 26 stroke patients during a pilot trial from April 2008 to October last year showed that patients recovered faster with this treatment than with traditional physiotherapy regimens.

Known as Brain Computer Interface or BCI-robot therapy, it involves placing electrodes on a recovering stroke patient's head, explained Dr Karen Chua, one of the project's researchers.

The patient's thoughts – for example, “move my arm” – will prompt a robotic arm, which she is grabbing in her stroke-affected hand, to move.

The doctors were researching the link between thought and action in stroke patients, which they believed would help patients regain limb movement such as moving their arms and gripping things.

For Madam Pakiam Thangveloo, whose speech became slurred and who needed crutches to walk after her stroke, the difference between pre- and post-robot therapy was stark.

The 60-year-old was hospitalised in TSH after suffering a stroke in January 2008, but found herself making little improvement after five months of physiotherapy.

In July, her doctor, Karen, suggested that she go for the BCI-robot therapy. Her regimen involved hour-long sessions three times a week over six weeks.

“Before the treatment, I couldn’t move my right arm at all,” said the grandmother of two. Post-treatment, she could move her arm and she has put away her crutches.

The power of thought

Apart from TSH, two other agencies are also involved in the trial. They are the National Neuroscience Institute and the Agency for Science, Technology and Research (A*Star).

Dr Gian Cuntai, A*Star’s lead researcher, pointed out that BCI therapies, which grew in the mid-1990s, have been used to assist patients to adapt to their environment – for example, an amputee controlling a prosthetic robot hand.

But Cuntai, who set up A*Star’s BCI research lab in 2003, is confident that the Singapore trial is the first in using BCI to help stroke patients recover.

Of the 26 patients in the study, 11 went on the BCI-robot therapy, 14 went on pure robot therapy and



Madam Pakiam Thangveloo, who suffered a stroke in January 2008, can now move her arm and has put away her crutches after receiving BCI-robot therapy for six weeks. PHOTO: ALAN TAN FOR THE STRAITS TIMES

What is BCI-robot therapy?

It looks like a scene straight out of a science fiction movie: You focus on an object and it moves.

No, this has nothing to do with psychic powers or magic: Witness the power of Brain Computer Interface (BCI) at work.

Coupled with robotics, BCI-robot therapy holds promise in that it could help post-stroke patients recover faster – a world first. It is pioneered by the Agency for Science, Technology and Research (A*Star), Tan Tock Seng Hospital and the National Neuroscience Institute.

In the therapy, electrodes are attached to the patient’s skull while she holds a rod attached to a robotic arm.

When the patient thinks of moving her arm, neurons are fired within the brain. This produces bursts of electrical activity, which is measured in an electroencephalography (EEG).

one dropped out of the programme.

Evaluations showed that those on the BCI-robot treatment experienced an average of 16.5 per cent improvement after four weeks. Patients had more range of movement in their arm and shoulder.

Improvements rose to 19.2 per cent after 12 weeks.

Compared to this group, those on pure robot-therapy – where the robot moved a patient’s arm automatically without her thought input – improved by 13.9 per cent after four weeks and 17.4 per cent after 12 weeks.

So, the BCI-robot treatment had done “surprisingly well”, said Karen, who is also a senior consultant at the hospital’s department of

rehabilitation medicine.

In BCI-robot therapy, the arm moves an average of about 140 times an hour while in pure robot-therapy, the arm moves about 1,000 times an hour.

Unaided by a robot, the patient can do only about 40 to 50 repetitions an hour.

In theory, more repetitions should bring about better results. But not so.

“We learn something in this process,” Karen said. “It is not just what you do but how you do it.”

She added: “In this case, thinking about moving your arm is more effective than actually moving your arm many more times. It’s a startling finding.”

Spurred on by the results of BCI-robot therapy, the doctors have

The BCI senses these EEG inputs and causes the robotic arm to move, pulling the patient’s arm with it. Not all patients are suitable for BCI-robot therapy.

Only patients recovering from a mild to moderate stroke qualify. That is because patients must be able to sit up for an hour – in a specially built chair – and focus.

Of the hospital’s 150-odd stroke patients seen during the trial period, 55 were eligible and 26 agreed to undergo the study.

Two engineers, an occupational therapist and a standby doctor attend to patients during the hour-long sessions.

Singapore’s A*Star researchers are some of the best in the world when it comes to EEG-based BCI.

At the most recent BCI Competition held in Vancouver, Canada, in December 2008, Singapore swept the first prize in all three EEG-based BCI categories among 35 submissions globally.

embarked on Phase 2 – a three-year study which began late last year and will run till early 2012.

Part of the funding will come from a \$36 million pool that A*Star will spend in the next few years to drive medical technology.

The sector, worth \$2.9 billion in 2008, should hit \$5 billion in 2015, according to statistics from the Jurong Town Corporation biomedical and chemicals cluster.

The doctors want to extend the study to other functions like finger and wrist movements and swallowing, and perhaps even come up with a portable BCI device which patients can use at home.

Cuntai is already talking to interested parties about commercialising the BCI-robot therapy and making it available to other hospitals.

Pakiam is all for the idea. “They should have more of this,” she said.

Chan Chi-Loong is a freelance writer

— MEDICAL INNOVATIONS —

Lokomat Systems

- Robotic gait training system
- Faster improvements in patient's walking functions and other mobility abilities

science.

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Getting back on his feet

Technician Teo Yong Seng (left and above), 49, suffered a spinal cord injury in March last year when he fell 3m while installing an air-conditioner condenser at a shophouse. He landed on his back and became paralysed in his lower body. In February this year, he started his Lokomat

robot-assisted walking therapy sessions at the Tan Tock Seng Hospital Rehabilitation Centre. Each session lasts 45 minutes, and he says it is more relaxing to walk on the machine than with the aid of a walking frame and a physiotherapist's support. ST PHOTOS: CAROLINE CHIA

Physiotherapy gets robotic boost

Lokomat system helps patients re-learn the technique of walking

■ BY JOAN CHEW

PATIENTS undergoing rehabilitation at the Tan Tock Seng Hospital (TTSH) Rehabilitation Centre can look forward to gaining independence faster with the help of robot-assisted walking therapy. The centre in Ang Mo Kio has signed a memorandum of understanding with Hocoma, a Swiss medical technology company, to focus on functional movement therapy using machines.

One of these, the Lokomat system, has benefited more than 100 patients since

TTSH acquired it in September 2008. It comprises harnesses to support the patient's body weight and a robotic gait support at the legs, and is used in combination with a treadmill.

The patient's legs are guided on the treadmill according to a pre-programmed physiological gait pattern.

The TTSH Rehabilitation Centre is the first in Singapore to use the Lokomat machine in physiotherapy sessions with patients.

At a demonstration, principal physiotherapist Wee Seng Kwee showed how it helps patients in re-learning the technique of walking. It is used in the rehabilitation of neurological patients following a stroke, spinal cord injury or traumatic brain injury, and those with multiple sclerosis and cerebral palsy.

But Mr Wee cautioned against the use

of Lokomat on osteoporotic patients as the robot may accidentally fracture the legs which have low bone density.

Mr Wee, 40, estimated that patients undergoing daily rehabilitation sessions may take their first steps - with a walking aid - only after five weeks.

But training with Lokomat can reduce this to just three weeks.

Dr Chan Kay Fel, head and senior consultant of TTSH Rehabilitation Medicine said patients can take up to 1,000 steps during a half-hour therapy session on Lokomat, compared to just 20 steps before both patient and physiotherapist are exhausted from manually assisted gait therapy.

Physiotherapists who have to exert considerable strength and effort to move patients' legs also run the risk of being injured in their back, shoulders and wrists.

Lokomat thus relieves the physical strain on therapists, explained Dr Chan, 49.

To complete a rehabilitation session with a patient, sometimes the assistance of three therapists is required to support his back, guide his legs and guide the walking aid, such as a four-legged walking frame, said Mr Wee.

With Lokomat therapy, a single physiotherapist is required to operate the machine and customise robotic gait training parameters according to the patient's ability.

Dr Chan said that this enhances personal productivity and is especially helpful for the more severely affected and very dependent patients.

In the next year, Dr Chan said TTSH plans to bring in more of such machines that aid in patients' rehabilitation pro-

cess. There are plans to bring in three other rehabilitation machines from Hocoma - the paediatric Lokomat to assist in rehabilitation for children; the Erigo, which helps neurological and bedridden patients move and sit up; and the Armeo, which helps patients regain functionality in the arms.

For now, one patient is glad to be able to use the Lokomat to work towards his goal of being able to walk unaided. Mr Teo Yong Seng, 49, became paralysed in his lower body after a spinal cord injury during a workplace accident in March last year.

Mr Teo, who has a cheerful disposition, said: "It's more relaxing to walk on the machine, and I believe it will really help me walk again."

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Supporting Research and Innovation – CRIO

- Clinical Research and Innovation Office (CIRO) developed to enhance support for research activities
- Overseas the following:

Clinical Innovations	Clinical Research	Clinical Trials
Innovations, collaborations and infrastructure support	Publication support	Feasibilities – site evaluation
Grants Management	Biostatistics and Epidemiology	Phase 2 to IV Studies
Agreement and budget negotiation	Grant writing and medical writing	
Intellectual property	Data management	
Regulatory submissions	Centre Grant	

Personalized Medicine Program

- TTSH is establishing a Personalized Medicine program
- Built around clinician-scientists from various specialties (breast surgery, endocrinology, ophthalmology, geriatrics and rheumatology)
- With the aim of generating new biomarkers for diagnosis and therapy
- To improve the standard of care both in Singapore and the South East Asian region

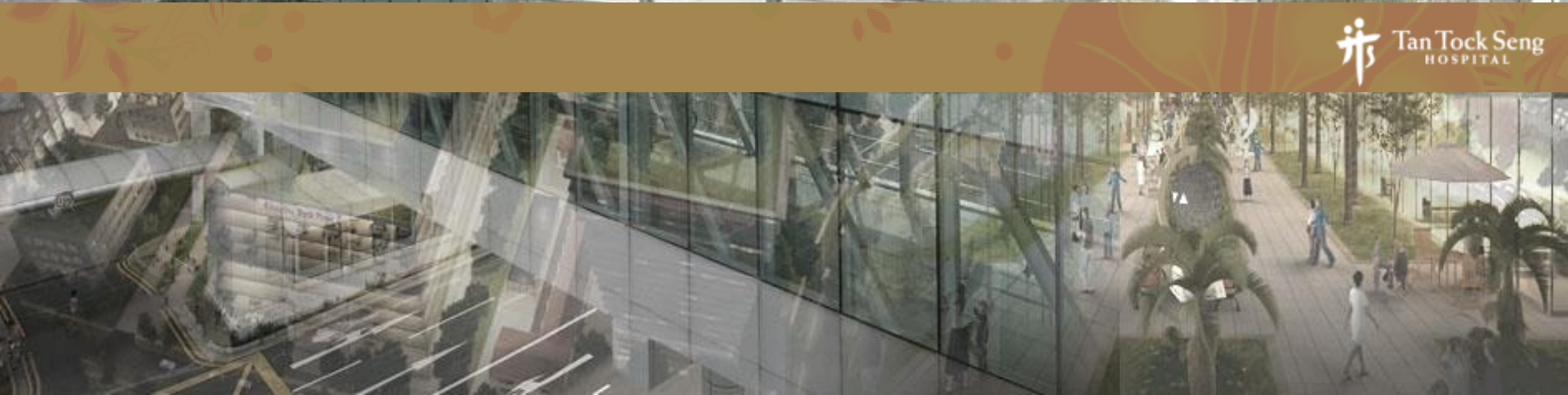
Summary

- Strong clinical specialties are our main drivers in clinical research. Personalized Medicine Program to galvanize our research effort
- Strong commitment from the medical leaders in TTSH to grooming clinician scientists and growing research
- Collaborations with other institutions and being the main teaching hospital for new medical school will accelerate our strive towards research and medical excellence



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THANK YOU



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