



REHABILITATIVE & ASSISTIVE TECHNOLOGIES: FROM HOSPITAL TO COMMUNITY

WRITTEN BY TJUT ROSTINA, CHI

The first of four instalments in the CHI INNOVATE 2022 conference series, the webinar featured two thought leaders as Centrestage speakers who addressed the value and impact of out-of-hospital recovery programme and mobile exoskeletons respectively. Taking the stage at the end of the session were a multi-national and diverse panel.

CENTRESTAGE 1 TRANSITION OUT OF HOSPITAL CARE AND REHAB

Health prevention and rehabilitation play important roles alongside curative therapies. This realisation would be pertinent in the transition out of hospital care. As such, it was necessary to focus on strategies that ensure that people can remain independent for as long as possible in their home setting and stay away from the hospital.

INTEGRATION OF MODELS

The focus was to develop the community and home-based models of care and integrate them into existing models. Recovery within the home setting would enable a move towards a higher quality of life and lower cost of care.

- Decision makers see it as an opportunity to hand over more responsibility to community healthcare providers, caregivers and the individuals themselves.
- When planning to give the responsibility of care for the patients in their home setting, they should be equipped with the right models of care and with the right technology.
- The patient should be empowered and to democratise healthcare. With the big companies focusing on this development to move healthcare into the community, this would mean a large financial investment into this field, and a collaboration with healthcare professionals and other key stakeholders.



Centrestage with Professor Michael Nilsson, Global Innovation Chair of Rehab Medicine from the University of Newcastle, and a Visiting Professor at the LKC Medicine.



NEW MODELS OF CARE

As rehabilitative medicine physicians, it was necessary to stay focused in the processes so as to influence the development of rehabilitative medicine and other connected specialities. It was important to take a systematic approach, but at the same time one that was individualised, where the system must have a multimodal core, be treatment centred, and evaluated with ease.

- The virtual approach should not be seen as replacing human interaction, but view it as enhancing, an “extension of your right arm and hand to monitor and find out more about your patients with a higher level of precision” in their home setting.
- Technology heavy, complex, difficult to understand solutions are not winners in this landscape going ahead. Simple, low hanging fruits, to start with, are good examples. And take it from there, build the technology systematically from the bottom.

Change management would take the longest to do. There was a need to rethink the healing environment, our healthcare, design, architecture and our interior as well.

FIRESIDE CHAT

- On cultural innovation, how would it be possible to build upon the current situation, as well as have partnerships with academics and industry that were relevant to patients and private stakeholders?

It would be essential to bring in people from different areas of expertise, with a passion for change to create a task force that would be dedicated to building an ecosystem. In building a culture that is long lasting, the right people would need to come on board.

- What were the essential processes that could help translate rehabilitation technologies from hospital to community?

On processes, there were a lot of factors to look into, especially on data security considerations, governance and requirements to develop technologies, even in institutional settings.

It would be important to start the different processes in parallel, to cater for delays and to accommodate current and existing silos. There was also a need to open up, create transparency and build trust among the people involved.

However, what would be most essential, was to select a pilot area and to prepare the introduction of this translation as much as possible through modelling. It could be the creation of a distributed Living Lab, in cooperation with the people in their home, and working together to tailor the solutions to suit the needs. Taking a rather simplistic view, implement the ones that would be easier to achieve, and then evaluate and see what was successful.

- How would the paradigm shift be driven towards adoption of technologies in the community?

To enable a paradigm shift, there should be:

- 80 percent change management and 20 percent technological change.
- Change management would refer to the full healthcare ecosystem, including the community that would help drive innovation and technologies forward to the community.

Engage the consumers and patients early on, ensure that the individual was at the centre of this effort, by sharing about the technology that has been developed, how it would be useful for them, and motivate to them to use it at home. It would also be imperative to have the leadership of the different organisations that support an initiative like this to be committed. This would potentially be a transformational shift that could change healthcare for years to come.



Prof Nilsson was joined by Dr Loh Yong Joo, Head of Tan Tock Seng Rehabilitative Medicine, for a Fireside Chat to get further insights.



CENTRESTAGE 2

1 MILLION STEPS ACHIEVED: ADOPTION OF MOBILE EXOSKELETONS TO IMPROVE FUNCTIONAL OUTCOMES OF NEUROLOGICAL CONDITIONS



Assoc Prof Wee Seng Kwee, Senior Principal Physiotherapist at Tan Tock Seng Hospital (TTSH), shared the various innovations that are currently in use, and which could be expected on the horizon for wider implementation.

The conference participants were able to view these mobile exoskeletons in action, and how it has benefitted patients in being more mobile and return to their daily lives. In a bid to continuously improve rehabilitation for patients, Prof Wee's team achieved one million steps in total by the patients in their care.

In a question posed by Dr Loh Yong Joo, Prof Wee replied what motivated his team to achieve one million steps within a short time for the patients in their care.

- Encourage team to try the exoskeleton therapy in different patient groups
- Positive impact on patients after analysing outcome
- Continuously brainstorm as a team on improvements to make
- Learn as a team

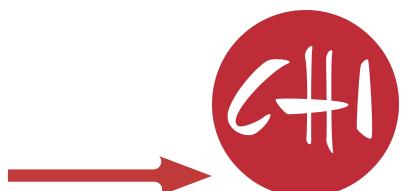
Factors for introduction of mobile exoskeletons to homes

- Make it affordable for home use
- Patients to undergo compulsory 6 months of therapy at clinic prior to using equipment at home
- Clinicians need to prove their clinical efficacy to healthcare insurance companies to gain support



***“Every Step is a Benefit.
Every Step is a Privilege.”***

Ms W W
5th August 2021



Rehabilitative & Assistive Technologies InnOvatioNs TrAnsLation (RATIONAL): When will we be ready?



(From left to right): Joining on stage for the panel discussion with Dr Loh Yong Joo after the Centrestage session were:

- Assoc Prof Wee Seng Kwee, Senior Principal Physiotherapist at Tan Tock Seng Hospital (TTSH)
- Mr Zen Koh, Co-Founder & Deputy Group CEO, CEO of Global HQ at Fourier Intelligence
- Adj Assoc Prof Karen Chua, Senior Consultant, TTSH Rehabilitation Centre, Clinic for Advanced Rehabilitation Therapeutics (CART)
- Ms Alexis Lau, Head of Rehabilitation and Wellness, Stroke Support Station
- Dr Shamala D/O Thilarajah, President, Singapore National Stroke Association; Principal Physiotherapist, Singapore General Hospital (SGH)

While there was no shortage of Rehabilitation Technology Systems in Singapore, how ready were rehabilitation professionals in ensuring that patients would be well supported to embrace and adopt tech-enabled models of care? Further to this, how can tech enabled rehabilitation service be kept sustainable? All this and more were discussed at this lively and engaging session, that kicked off with the panellists and audience polling on the community's readiness for tech enabled rehabilitation with a general score of 6-8 over 10 for the polls.

- **People – Providers and Patients**
 - The rehabilitation team should have the skill set to run these tech-enabled innovations.
 - The patients would need to have awareness, understanding and co-ownership of the technologies that would be implemented.
- **Programmes**
 - There would be a need for different suites of rehabilitation programmes that embrace technology as an enabler.
- **Products**
 - Work with industry partners to develop products that cater to a patient's specific needs.
- **Partnerships**
 - Build partnerships from hospital to community for the patient's smooth transition.

In summary, due to these "P"s, a move towards paradigm shift would be more possible, and would result in a more personalised care for patients.



Rehabilitative & Assistive Technologies

InnOvatioNs TrAnsLation (RATIONAL):

When will we be ready?

The audience were invited to engage the panellists with their questions and those that could not be answered during the event due to time, were as follows:

Q1: Great sharing of inspiring cases by Prof Seng Kwee. What remains the major barrier to widespread use of exoskeletons in the community? Will it be easy for us to train caregivers rather than therapists guide patients in use of exoskeleton's?

A/Prof Wee: The usage of exoskeleton for mobility is not simply strapping a person into the exoskeleton and off he/she goes walking. There would be a tremendous amount of deep clinical reasoning involved in the provision of exoskeleton therapy.

The well-trained physiotherapist would need to observe the person's gait pattern and customise a number of key parameters to that individual in order for the walking practice with the exoskeleton to be smooth and efficient; matching as close to the normal gait pattern and gait cycle.

The critical parameters of the exoskeleton setting include step length, step height, swing time, swing trajectory, amount of hip and knee support. These parameters have an impact of how a person walks with the exoskeleton. In view of the complexity of such settings, which may be slightly different per treatment session, it was challenging for caregivers to guide the patients in the use of exoskeleton in a safe manner.

In the US, the caregivers require up to 6 months of intensive training on using the exoskeleton to walk their loved ones. Following that training, the caregivers underwent stringent competency audits before they are certified competent and safe by the physiotherapists. It was with such robust and stringent training process in place that their loved ones could purchase a personal exoskeleton device. This model of stringent training could be a model that Singapore could emulate, modify and adopt in the future for more adoption of exoskeletons to improve mobility of people with disability in the community.

Q2: Where you able to test the exoskeleton with patients in the older age group (65 and above) and if so, what was your experience like?

A/Prof Wee: The TTSRH Rehab Physiotherapists have provided exoskeleton therapy for older adults with neurological conditions such as stroke, traumatic brain injury and spinal cord injury. The older persons were generally very open to trying therapy coupled with rehabilitation technology to aid their recovery. The outcomes post robotic exoskeleton therapy have been positive thus far in terms of improvement in trunk control, lower limb strength, coordination, walking abilities, cardiovascular fitness and patient-reported quality of life measures.

Q3: Is there any carry-on effect as Transfer of Practice with EXO, that the patient would be able to walk without it after a period of training?

A/Prof Wee: Yes, our physiotherapists have certainly observed translation of the gains from the exoskeleton therapy to functional activities. Even for patients who were still non-functional ambulant post therapy, there was positive improvement in their trunk control such that they could sit better and longer with more erect posture. Other patients have reported improvement in their transfer ability due to improved lower length strength and trunk control; hence reducing the burden of care for their caregivers. These were still important rehab goals to the individuals.

For patients who have shown improvement in their locomotor ability post robotic exoskeleton therapy, there was a critical need to train their dynamic balance and overground gait training, building on the gains made after robotic therapy. The combinatory approach of customised conventional physiotherapy and robotic therapy was key to optimising the patients' mobility. Some patients could gradually ambulate with walking aids with minimal assistance or contact guard assistance or even achieved supervision level walking. There were some who could eventually ambulate without aids under supervision of the caregiver.



Rehabilitative & Assistive Technologies

InnOvatioNs TrAnsLation (RATIONAL):

When will we be ready?

Q4: What do you think would be the scope of exoskeleton in inpatient rehabilitation? And to complement the conventional therapy for neuro rehab, would you recommend the increased intensity of rehabilitation specific to exoskeleton?

A/Prof Wee: Yes, there is certainly a place for exoskeleton therapy in the inpatient rehabilitation setting. Wearable robotic exoskeleton is a promising new rehabilitation therapy that could provide individualised, high repetitions and high-intensity gait training. The robotic exoskeleton minimised users' abnormal posture and movement; and enabled them to experience walking in a normal physiological gait pattern as part of motor relearning post neurological insults. Due to the intensive gait training, the exoskeleton has the potential to improve patients' gait pattern, gait efficiency and cardiovascular fitness.

A recent randomised controlled study by *Kim et al (2020) demonstrated increased cortical activation in the robot-assisted gait training (RAGT) group compared to the control group receiving conventional physiotherapy. In addition, the researchers found that the early start of RAGT could accelerate bi-hemispheric reorganisation in the motor elated brain regions. Taken together, exoskeleton therapy could be provided for acute and subacute patients if there were no contraindications, to promote neuroplasticity and hence recovery.

Exoskeleton therapy and other robotic and virtual reality therapy for the upper and lower limbs were expensive as there were no government subsidies for such novel therapies. I sincerely hoped that the Ministry of Health would consider subsidies to support such novel therapies to optimise patients' outcomes. One thing for certain, TTSH does not deny any patient access to technology-aided therapy if she/he requires it. For patients with financial challenges, our medical social workers would offer advice and assistance in order for them to receive technology-aided therapy to aid their recovery.

*Reference

Kim DH, Kang CS, Kyeong S (2020) Robot-assisted gait training promotes brain reorganization after stroke: A randomized controlled pilot study. NeuroRehabilitation 46; 483-489.

Q5: In 2022, what would be the most important direction for an OT/physiotherapist to more effectively get involved in promoting medtech or advanced rehabilitative technologies? Focus on translational research work or client-centered practice?



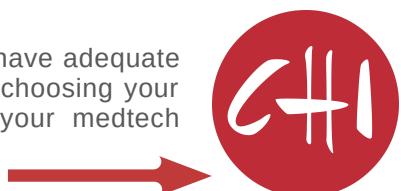
Dr Karen Chua: My suggestion would be that a fine balance for both are needed:

(i) for client centered practice: this would be where you would identify your problem statements, classify them. Identify the gaps (either in structure or practice or pathway). When you apply a new medtech or rehabilitation technology, it was important to remember that the technology was an enabler or extender to your existing evidence-based practice and tech was not the main focus but the interactions between the tech and client/practitioner to improve your practice. If the technology is evidence based, but was cumbersome or laborious or unsafe to implement, then it was not the right fit, right time or right approach.

Data on outcomes or QOL using usual standardised clinical outcomes must be used at periodic intervals as well as patient reported outcome measures (PROMS).

(ii) Where translational research was concerned, think synergies and scale up slowly and organically. If you were starting out, take small steps which could be contextually relevant or grounded to your clinical practice work flow. A "kampong" was important as you would burn out if you try to be the lone general. Very often, the driving energies /engines come from the multi disciplinary interprofessional groups either within your institution or externally via scientists or medtech innovators as well as administrators.

Always budget for clinical headcounts/partial FTE in your research grants to have adequate manpower, start small and scale up. And remember to protect your joint IP, choosing your medtech partners carefully from the start! I wish you the very best in your medtech innovation journey!



Rehabilitative & Assistive Technologies InnOvatioNs TrAnsLation (RATIONAL): When will we be ready?

Q6: Why can't assistive tech be deemed as a consumer product that does not need to be fully integrated into our health IT infrastructure?



Mr Zen Koh: Some assistive techs were still complex and require professional advice and training for safe usage. These were techs such as exoskeletons and powered wheelchairs. Some manufacturers also price the assistive technology in a higher range that may not be affordable to the general consumer. With this, certain countries impose a thorough assessment to fund and provide the appropriate assistive technology to the user. This was a lengthy process that usually involved multiple healthcare providers. So, until we could lower the cost associated and the complexity of the available tech, it was unlikely to see these as consumer products.

Q7: How do you foresee the feasibility and barriers of getting exoskeleton at home setting for the patients? And how to optimise the sustainability?

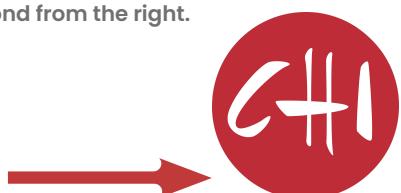
Ms Alexis Lau: Feasibility of integrating exoskeletons into the home setting for personal or everyday living depends on several factors, with cost being one of the biggest barriers. Although prices were coming down, current costs were still not affordable for the vast majority of patients.

Additionally, since capabilities of exoskeletons differ and the purpose of use at home can also vary, other factors such as the weight and modular design of exoskeleton, complexity in operating the device, pre-training requirements also contribute to its feasibility for the home setting. While the use of exoskeletons at home may seem remote at this point, at least in Singapore, with the rapidly growing awareness of robotic technologies and its benefits, increased opportunities for its adoption will likely unfold with time.

As technology development allowed more varied applications for home and community use, the demand required stronger collaborative and concerted efforts from various stakeholders (end users, funders, insurance companies, etc) to ensure sustainability of increased production, adoption and utilisation. Monitoring market dynamics such as the growing trend of utilization of exoskeletons, its technological development, as well as the challenges that come with its implementation, and the unravelling of new opportunities for patients would be crucial in ensuring success in technology translation to the community.



Ms Alexis Lau, Head of Rehabilitation and Wellness, Stroke Support Station as pictured second from the right.



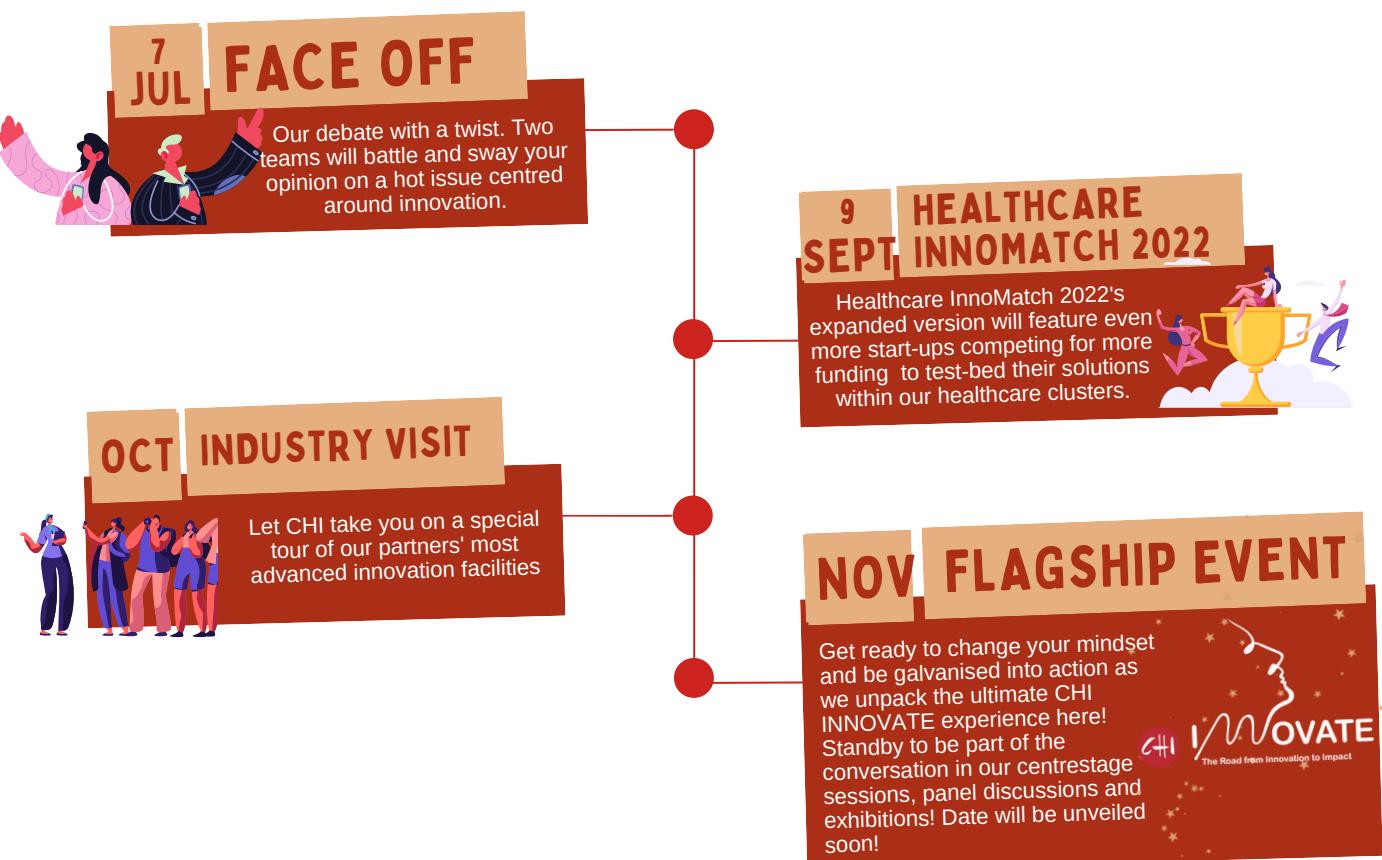
Rehabilitative & Assistive Technologies InnOvatioNs TrAnsLation (RATIONAL): When will we be ready?

Q8: Understand that translating the use of technology in rehab across settings, involves change management and funding. How should one decide when to continue to press on with tech and when does one decide to give up?



Dr Shyamala: If I understood this question correctly, it was about bringing technology in for service provision. The team may need to evaluate different types of rehab technology and find a suitable one that would match the clinical need and budget. If the team have decided that a certain technology could offer opportunities for patient to stand/walk /run that may not be humanly possible to deliver then we should persevere. Apart from organisation funding, a team can also apply for grants or collaborate on research projects that could allow the tech to be used in the clinical environment.

WHAT'S NEXT?



**CENTRE FOR
HEALTHCARE
INNOVATION®**

