Research Assessment Exercise 2020
Impact Case Study

University: The Hong Kong Polytechnic University
Unit of Assessment (UoA): 05 Nursing, Optometry, Rehabilitation Sciences and Other Health Care Professions

Title of case study: Effective post-stroke interventions for promoting functional recovery and community reintegration

(1) Summary of the impact

Stroke is highly prevalent worldwide. It causes severe physical and cognitive impairment, and poses challenges to recovery, self-care independence and transition from hospital to home. The HK PolyU team has developed effective, evidence-based clinical and post-stroke care strategies, and innovative rehabilitation devices for promoting functional recovery and full community reintegration. Our research has had a wide reach and has become of high significance through our new clinical guidelines, protocols for mobility and a new dual-task paradigm for fall prevention by rehabilitation service providers. These rehabilitation products have been commercialized. For example, sensory cueing wristwatches for the treatment of unilateral neglect and a virtual reality-based cognitive training system have been on the market since 2012 and 2014, respectively.

(2) Underpinning research

The key researchers (in alphabetical order) who contributed to the impact outlined in this case study are: Professor Christina Hui Chan, Dr Kenneth Fong, Professor David Man, Professor Gabriel Ng, Professor Shamay Ng, Professor Marco Pang , Prof Chetwyn Chan and Professor Frances Wong.

Stroke leads to a wide range of physical, communication, emotional, behavioural and cognitive impairments, placing a huge burden on those affected, their relatives and society. Since 2000, our research platform on rehabilitation, care and support needs of the ever-increasing stroke population has produced findings that address and help solve the complex problems offset by stroke: by improving treatment and rehabilitation, by promoting self-help and by enhancing the full re-integration of stroke survivors into the community. In addition, innovative, effective and commercially available rehabilitation tools have been developed.

We designed the first protocol for Transcutaneous Electrical Nerve Stimulation (TENS), combined with task-related training, for improving lower limb function [R1] in 2009. This has proved to be effective and is now widely used by physiotherapists to decrease plantar flexor spasticity, improve dorsi-flexor and plantar- flexor strength, and increase gait velocity, thereby promoting functional mobility. We developed a cognitive-motor dual task training protocol for augmenting balance and walking performances in 2016 [R2]. Another cognitive behavioural therapy (CBT) protocol with task-oriented balance training became a reality in 2019. This protocol is effective in reducing the fear and risk of falls, and in the prevention of fall-related injuries [R3].

Our technology-focused research employed an effective and innovative stroke rehabilitation product, the patented ‘Remind-To-Move’ (RTM) protocol, in 2010. RTM is based on attention theories, effective in promoting stroke patients’ awareness of the paretic limb after hemiplegia, and tracing the actions associated with the awareness. This device is now widely distributed to both local and overseas users including patients and therapists. It has also become an integral part of a commercially available tele-rehabilitation system, providing better functionality to international user groups [R4].

Since 2010, we have again developed tailored virtual reality (VR) tools for training in basic and advanced cognitive skills, which are applicable to daily-life scenarios such as shopping and taking public transport. Based on the environmental enrichment theory and neuro-training regime, positive cognitive outcomes and a high transfer ratio to real-life activities are evident. A first-of-this-kind prospective memory (PM) test and training system have been constructed to ensure the timely addressing of an often-neglected cognitive function that determines independence and quality of life [R5].

(3) References to the research

[R1] Ng SSM, Hui-Chan CWY. (2009). Does the use of TENS increase the effectiveness of exercise for improving walking after stroke? A randomized controlled clinical trial. *Clinical Rehabilitation*, 23, 1093-1103. https://doi.org/10.1177/0269215509342327

[R2] Yang L, He C, Pang MY. (2016). Reliability and validity of dual-task mobility assessments in people with chronic stroke. *PLoS One*, 11(1), e014833. doi:10.1371/journal.pone.0147833

[R3] Liu TW, Ng GYF, Ng SSM. (2018). Effectiveness of a combination of cognitive behavioral therapy and task-oriented balance training in reducing the fear of falling in patients with chronic stroke: study protocol for a randomized controlled trial. *Trials*, 19, 168. doi: 10.1186/s13063-018-2549-z

[R4] Two patents have been published for "Remind-to-Move"

- USA patent published on June 24, 2010 for "A wearable portable device for increasing user awareness of a paretic limb and recording the user awareness" (Publication No. US-2010-0160834-A1).
- China patent published on August 17, 2011[中华人民共和国专利申请: 一种增强用户偏瘫肢体的意识并记录用户意识的可佩带式便携装置、系统及方法 (CN 101757778 B). 授权日期: 2011 年 8 月 17 日]

[R5] Yip BCP, Man, DWK. (2013). Virtual reality-based prospective memory training program for people with acquired brain injury. *NeuroRehabilitation*, 32(1), 103-115.

[R6] Yeung SM, Wong FK, Mok E. (2011). Holistic concerns of Chinese stroke survivors during hospitalization and in transition to home. *Journal of Advanced Nursing*, 67(11):2394-2405. doi: 10.1111/j.1365-2648.2011.05673.x.

(4) Details of the impact

Worldwide, stroke is the second most common cause of death, responsible for ~12% of all death. It is also the third most common cause of disability. The Hong Kong Department of Health estimated that 40,000 people aged 65 and above, living in the community, suffered a stroke in 2010; this is estimated to increase three-fold by 2036. Stroke often leads to a wide range of impairments that seriously constrain physical and cognitive functions and compromise the quality of life. It also imposes a large socio-economic burden on families and society. Since 2013, our research has actively developed a holistic approach to tackling a variety of problems with proven efficacy in improving the

healthcare and rehabilitation of stroke survivors, changing practice, and developing innovative and commercially available rehabilitation tools for the ever-increasing number of local and global stroke survivors. Therefore, the reach and significance of our stroke-related research are high.

Adoption of stroke rehabilitation clinical protocol by local hospitals and NGOs to improve motor recovery rates

Our TENS protocol over acupuncture points has extended from the majority of hospitals to local communities. For example, this motor recovery programme has been distributed, since 2015, through Aberdeen Kai-Fong Welfare Association Social Services [S1], which has a membership of over 16,000, consisting mostly of elderly clients, and has served an average of 148,937 recipients each year.

Another protocol designed for training attention, mobility and balance has become an integrated part of hospital practice. Moreover, the dual-task program has become a new treatment regime used by SAHK (one of the largest NGOs in Hong Kong) since January 2019 [S2]. A total of 8 PTs and 51 service users of SAHK participated in these training activities. The exercise protocol referred to S2 is shown in S8.

SAHK's testimonial is that *"After the sharing and training, we attempt to incorporate dual task training elements into our groups and individual trainings for stroke survivors, school aged and adults with developmental disabilities … and in different settings. We plan to extend an adapted application in a home-based setting in the near future".*

Impact on health and welfare

A 4-week Transitional Care Programme (TCP) for discharged patients was launched from 2009 to 2012 in a local hospital (Alice Ho Mui Ling Nethersole Hospital). The Director of the Nethersole Institute of Continuing Holistic Health Education commented that "*As for the feedback from staff in our stroke unit, they receive positive response from patients and their carers after the implementation of the program.*" A total of 1000 TCP-based Home Rehabilitation Handbooks, published since 2009, have been fully distributed and have brought significant benefits to stroke survivors [S3].

Another self-management protocol on the Patient Empowerment Program (PEP) was launched in the health and social welfare sectors. This programme is based on self-management and ICF concepts for improving self-efficacy and aims at better symptom management. To date, the Hong Kong Society of Rehabilitation, 39 patient resource centres of the Hospital Authority and other Asian countries, such as Singapore, have launched this program [S4].

Impact on commerce

Since 2012, 44 pieces of our patented "Remind-to-Move (RTM)" device, a wearable sensory cueing device for stroke survivors with unilateral neglect (an attention disorder) have been produced by The Hong Kong Polytechnic University in collaboration with the Department of Engineering. They were sold through *The Hong Kong Polytechnic University Technology & Consultancy Company* Limited (PTec) to 13 major hospitals. Four additional pieces were sold to the Kessler Rehabilitation Centre in the United States [S5]. *Caspar Health Limited* has licensed and integrated this device into their company's tele-rehabilitation system. *Caspar* approached us in 2015 after a site visit. On 1 March 2018, a HK $ 1 million donation fund was set up by *Casper Health Ltd* to further support our industry-focused healthcare products [S6].

A VR-based rehabilitation software system (VRehab) was designed to treat the cognitive problems associated with stroke. The VR-based community living skill training programme was developed alongside a VR-based vocational training system or Virtual Boutique (VB), and these have been distributed to healthcare centres through PTec and their strategic partner *C2 Innovations and Research Limited* [S7] since 2013. The users of this system currently include hospitals and local non-governmental agencies that have adopted a blended service mode by merging human and computer-aided service modes for their daily training. The VR systems have been sold to seven hospitals, nine NGOs and two educational institutes. The CEO of the company commented that "*The number and types of service users of our VR based rehabilitation platform have been a successful one and has become one of the key pioneers in VR rehabilitation tool developer for clinical use".*

(5) Sources to corroborate the impact

[S1] The protocol of applying TENS over acupuncture points has been applied in local hospitals and communities on people with stroke. It has been reported in News Bulletin of Aberdeen Kai-Fong Welfare Association Social Services (香港仔坊會社會服務). News Bulleting is in S1 attached and the link to the newsletter (refer to p. 8):

http://www.aka.org.hk/images/publication/max/eldwin_48.pdf

[S2] Clinical applications of Dual Task Training in SAHK. Motor and cognitive training become an integral part of community-based outpatient rehabilitation for stroke survivors.

[S3] Stroke Rehabilitation Education Handbook, published by Nethersole Institute of Continuing Holistic Health Education for the use of patients in Nethersole Hospital. Letter to show evidence in clinical use is attached.

[S4] The randomized controlled trial on self-management protocols for patients with chronic illness in 2007 in Hong Kong has been translated into a collaborated service with the Hong Kong Society of Rehabilitation to serve post-stroke populations

https://www.rehabsociety.org.hk/dccs/crn/strokecomrehab/

[S5] Thirteen local hospitals have been equipped with the system "Remind-to-Move", in the form of a sensory cueing wristwatch. Similar application in the US is evidenced by the Kessler Rehabilitation Center in New Jersey. The sale record demonstrates its wide usage and clinical impact on unilateral neglect rehabilitation of stroke patients.

[S6] Collaboration proposal in launching a commercial platform incorporating e-system from Caspar and Remind-to-move from The Hong Kong Polytechnic University [(please refer to pp. 12-15)

[S7] Strategic partnership with C2 Innovation and Research Limited on commercialization of cognitive rehabilitation product and several sponsoring agencies. http://c2i.com.hk/

[S8] Exercise protocol referred to S2.