Hospital Observation and Clinical Trials for the Development of Low-cost Outpatient Hand Rehabilitation Solutions for the Elderly Post-injury/stroke

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1. Summary

This report describes our team's work in the development of outpatient hand rehabilitation solutions for the elderly post-injury/stroke. We conducted hospital observation to understand the needs and clinical trials to validate the performance of the solutions. Patients and therapists were involved in this study. Following fieldwork and data analysis, we designed a portable solution for hand rehabilitation for elderly.

2. Aim of Research

The number of the elderly requiring hand rehabilitation, as well as other medical services, is on the rise. Such phenomenon are brought about by various causes, such as the longer life expectancy, the likelihood of elderly to live by themselves, and so on. These needs are in the upward trend, as the elderly population is expected to grow in the years to come; in Singapore,

for example, the ratio of senior citizen to working-age citizen is expected to grow from 1:4.8 in 2015 to 1:2.1 in 2030[1].

The measurements of hand function, such as hand strength and hand stability, for the elderly are important as they have been demonstrated to be valid predictors for the human's overall health condition[2]. However, measurement to meet such need has so far not been easy, even using existing standard devices as they are neither able to gauge the hand stability nor are they simple to use. Yet the formulation of problem has not been firmed, and hence the problem itself persists.

This study aims to determine the unmet needs of the elderly with respect to post-injury/stroke hand rehabilitation – as well as other medical conditions – and to address the key identified needs by designing solutions with regard to hand rehabilitation.

3. Method of Research and Progression

Our study investigates rehabilitation solutions for elderly by means of Design Thinking methodology, centered on the iterative process of observation and trial in hospitals. The observation is aimed at understanding the real needs of the elderly during rehabilitation and the latent difficulties and situational challenges that they face during the process, while the trial is aimed at understanding the performance of the solution to address the identified needs and as means of validation that the solutions.

Integral to the observation and clinical trials is the design and development of solution to hand rehabilitation. We applied design methodology, which includes formulation of design specifications, prototyping, etc.

[1] Source: "A sustainable population for a dynamic Singapore", 2013, http://population.sg/key-challenges/

[2] Source: H. C. Roberts, et al., "A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardized approach", *Age Aging*, **40(4)**, pp. 423-429, 2011.

4. Results

Our observation revealed that patients – including elderly patients – are in hospitals for planned and unplanned reasons, whose estimated proportion is as depicted in Figure 1. For both reasons, however, there is similarity in that the waiting time spent at the hospitals is rather significant – and this is despite the visit being planned.

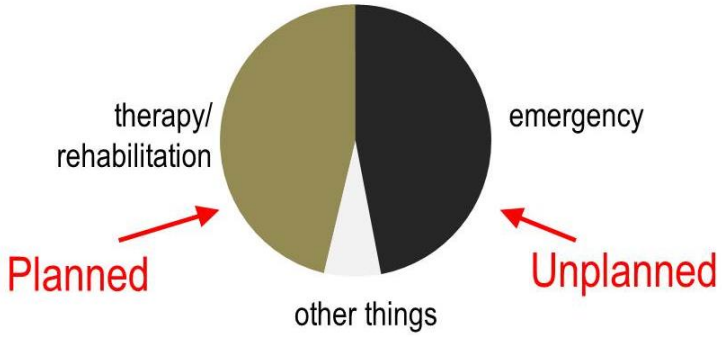

Figure 1: Planned and unplanned visit to hospitals

We therefore envisioned a portable and independent system to allow less-critical patients to perform rehabilitation exercise without the need of having medical staff direct supervision. Such system is then developed and tested, as presented in Figure 2. It comprises of a rehabilitation end effector – in the form of a gripper as an example – and an online system that can be accessed through apps, websites, or other means. Such online system allows monitoring and indirect supervision by medical staff. This device was tried in a voluntary trial, involving a therapist and two elderly persons.

Figure 2: Portable, on-line rehabilitation device

5. Future Areas

Given that this device treats versatile symptoms of hand grip, there is also a possibility of using such methodology to measure post-stroke spasticity; i.e. the velocity-dependent response of muscle to passive stretching[3]. From the feedback provided by users, we are moving towards deeper data analysis and data presentation.

6. Means of Official Announcement of Research Results

The result of this study has been accepted and will be presented at the Singapore Rehabilitation Conference 2015, titled “An upper limb rehabilitation device with strength and stability measurement capability”, 26 – 27 March 2015. An acknowledgement to the support from Mitsui Sumitomo Insurance Welfare Fund (MSIWF) will be made accordingly.

[3] Sources: J. W. Lance, “Spascticity: disordered motor control”, a symposium synopsis of “Symposia specialist” by R. G. Friedman, et al. (eds), Miami, USA, pp. 485, 1980; and E. W. Jones, G. P Mulley, “The measurement of spasticity”, in “Advances in stroke therapy” by F. C. Rose (eds), New York, Raven Press, pp. 187-195, 1982.