The Design of Pain Management and Creative Service for Older Adults with Chronic Disease

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Abstract. Chronic Disease is expected to affect approximately 3 million older adults by the year 2030 in Taiwan. It is one of the top causes of disability, mobility problems, and chronic pain among older adults. With so many individuals affected, it is important to identify how to effectively manage the pain associated with chronic pain disease. The purpose of the present research was to understand the factors and needs critical to the successful management of chronic pain and to create the management and service tools currently available to the older adults. We conducted structured interviews with subject matter experts, target user, and brainstorming for the pain management development. All of the process reviewed were found to be current chronic problem pain lacking in several key areas, such as failing to include critical variables and difficulty integrating the data collected into a meaningful representation of one's pain experience. Resolving these issues will improve the quality of life for individuals suffering from chronic pain. The researches provides 3 pain care system concepts through the convenience of household devices combined with cloud computing technology, touch interface and information design (The Pain Tracker, The Pain Helper, The Pain Exerciser). According to older patients with chronic pain, considering the both of physiological and psychological part of the demand to conduct innovative service design, the health care self-management concept will enhance the better quality of life of older chronic patients.

Keywords: Chronic pain · Older adults · Pain management

1 Introduction

According to the statistical data from the Ministry of the Interior (2012), Taiwan, published at the end of May 2012 (the 101st year of the Republic of China), 10.14 % of Taiwan's population was older than 65 years. The proportion of elderly persons in the population was estimated to reach 19.7 % (Ministry of the Interior, 2010) by 2031 (the 120th year of the Republic). With the rapid increase in the elderly population, the

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health of the elderly has become a concern. Statistical analysis showed that chronic illnesses account for nine of the top 10 causes of death among the elderly in Taiwan (Department of Health, 2009). Moreover, according to data from the Statistics Office of the Ministry of the Interior (2000), 76.06 % of the elderly citizens have chronic illnesses. Based on this disease pattern, chronic illnesses can be considered as the leading cause of death and a major threat to the health of the elderly. Although age itself is not an illness, the physiological changes and reduced functionality that come with it increase the risks of health problems and disabilities. In addition, health problems in the elderly are often complicated by comorbidity, concomitancy, concurrency, and cumulative or additive conditions. They are also mostly chronic in nature. In view of this, the Department of Health (2011) has been actively promoting chronic illness prevention and health maintenance plans in recent years. It has also promoted awareness of the measures to prevent chronic illness and maintain health in order to popularize and elevate the quality of care of the elderly with chronic illnesses.

Of the chronic illnesses in the elderly, pain is the most common symptom and has the greatest effect on their quality of life. Pain can exacerbate the symptoms of an illness and cause unexpected bodily changes. For example, pain in a patient with a heart condition may trigger myocardial infarction. A clinical documentation indicated "soaring blood pressure due to pain, causing the patient to suffer intracranial hemorrhage," which is a life-threatening condition. Pain can also reduce patient quality of life. An investigation by Partners Against Pain (PAP) in the United States found that once pain occurs, the basic functions of life deteriorate. The most common effect of pain is insomnia, which occurs in 56 % of cases, followed by emotional effects in 51 % of cases. Furthermore, pain causes the inability to operate a vehicle in in 30 % of cases, lack of sex drive in 28 %, and loss of appetite in 7 %. In addition, pain can cause economic losses. The US Center for Disease Control and Prevention conducted a statistical census on health among US citizens and discovered that approximately 76 million Americans have chronic pain distress (Davis and White 2008), far exceeding the number of patients with diabetes, heart disease, and cancer. In terms of medical expenses and loss of productivity, chronic pain costs Americans an average of $100 billion per year.

Chronic pain can limit a sufferer's activities, is associated with social isolation and depression, presents challenges to sense of self, and can dramatically affect quality of life (Berman et al. 2009*). Older people with chronic pain are likely to experience more physical impairments and interference with activities than younger people, and patterns of pain location tend to broaden with age. Widespread pain may especially affect the progression of disability and impaired mobility (Blondal and Halldorsdottir 2009). The subjective experience of chronic pain, in particular negative thinking and stress, can play an important role in the management of pain, communication of pain to others, and treatment outcomes and can exacerbate pain or the disease process leading to pain. Self-care strategies for managing stress, facilitating positive coping behaviors, or reducing anxiety may be especially effective for mediating psychological and social components of pain management (Foster 2007). For instance, behavioral-cognitive therapies often focus on maladaptive coping responses, perceived helplessness, and low self-efficacy for pain management (Hirsh* et al. 2009*). These therapies, including mind-body approaches, have demonstrated benefits for a wide variety of pain*

conditions, particularly interventions with multiple components or approaches. They have been associated with reductions in pain frequency, pain intensity, pain duration, depression, anxiety, and medication use, as well as improvements in self-efficacy, ability to control pain, coping, activity levels, and health-related quality of life (Medynskiy and Mynatt 2010).

There is growing evidence that older adults will use and benefit from technological complementary and alternative medicine and mind-body therapies (Borders et al. 2005*). Future cohorts of baby boomers may be more inclined to use such therapies because there are more older adults are likely to turn to the cloud technology for health information. Delivering self-care pain management service* via *the cloud technology may be of particular benefit for people in chronic pain who are isolated or have difficulty leaving the home (Peat* et al. 2001*). Technological access to self-care pain management service overcomes previously identified barriers to participation among older people such as lack of transportation, inability to travel, time conflicts, and reluctance to participate in a group or associate with other frail individuals. The benefits of technological self-care pain management service for a variety of health conditions appear to be comparable to in-person interventions. For instance, a cloud technology -based chronic disease self-management program demonstrated improvements in self-efficacy and health status, and a web-based stress management intervention showed reduced stress and improvements in ability to manage stress. Technological self-care pain management service addressing pain due to a variety of conditions have also been associated with decreased pain and increased control over pain; reduced catastrophizing of pain and maladaptive coping; reduced disability and improved role function; reduced depression and perceived stress; decreased physician visits and time spent in hospitals; and increased work hours.*

With the imminent aging of societies and the increasing tendency of illnesses to become chronic, more elderly people will develop chronic illnesses in the future (Van Baar et al. 1998*). Perfecting self-care of pain will not only satisfy the health needs of the elderly but also help them achieve their maximum potential within their limitations due to their diseases, maintain their health and independence, increase their control over their lives, and help them achieve their optimal physiological, psychological, and social conditions. Therefore, self-management of pain in chronic illnesses is a most basic level of health care for the elderly and the most important self-care strategy.*

2 Technological Self-Care Pain Management Service Design Process

2.1 Prospective Science and Technology

This prospective plan anticipates the use of mobile medical technology and applications, combined with various mobile and wearable devices equipped with relevant hardware and software for information security and functional authentication. Mobile medical care overturns the traditional health-care relationships. Its application is no longer confined to face-to-face treatments at fixed locations or to computer terminals. The development of mobile medicine is aimed toward overcoming the limitations of

time and space, and combining mobile equipment with the hospital information system (HIS) in order to implement mobile medical care. It will instantaneously provide elderly patients with chronic diseases with all types of pain information, record-keeping systems, and querying via the cloud infrastructure.

With the full development of key technologies, including WiMAX, RFID, Sensor, and RF, the aim is to use these technologies to integrate all pain self-monitoring and management systems. With the cooperation of remote care centers, the elderly population can be offered comprehensive, instantaneous pain management care. Family members can use remote medical care application software on their cell phones to check on any facet of their elder's chronic illness pain management status at any time and place, even overseas. Families can then work together to promote the health of their elders and improve family interaction.

2.2 Design Process

The design process included the following steps: design concept and scope, existing product analysis, brainstorming and creative thinking, concept sketches, design concept revision, and concept solidification procedures. Then, the design concepts were finalized and presented.

A. Design concept and scope
This stage of the design work was based on the basic goal and direction of the design. Creative concepts were proposed according to the concept schemata derived from lifestyle analyses and approved in order to fix the scope and direction of the design (Fig. 1).

Fig. 1. Image *board for the design concept and scope*

B. Brainstorming and creative thinking
After converging on chronic pain and lifestyles of the elderly, we conducted the first-stage brainstorming and creative thinking session to identify forward-looking design concepts and key words (Fig. 2).
C. Concept sketch
We sorted through the concepts generated in the previous step, narrowing down the options and selecting the most innovative concept directions. We ended up with three major conceptual directions for product development.
D. Design concept revision
After repeated proposals to amend the concepts, we invited a professional designer to suggest improvements of the three conceptual products and to supplement or correct any conceptual deficiencies (Fig. 3).

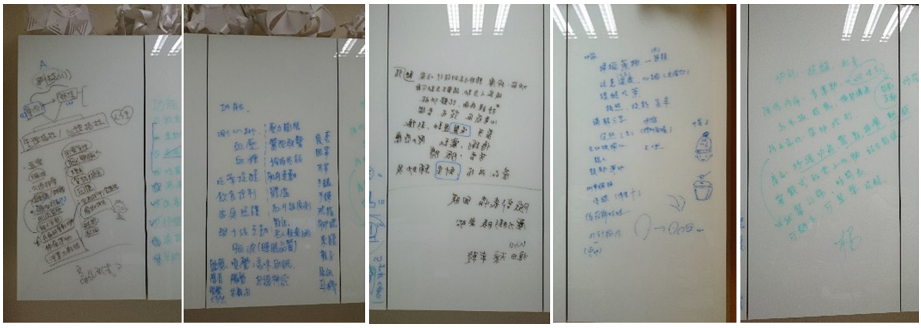

Fig. 2. The *outcome of brainstorming*

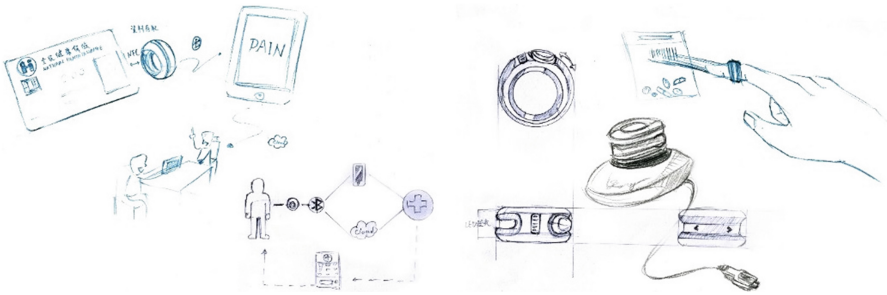

Fig. 3. Design *concept sketches*

E. Solidification of the concepts
We further revised the three concepts from the previous steps and solidified their details in this step. We used three-dimensional (3-D) software rendering to present the integration of specific modes of operation, technology applications, visual design, and aesthetic appearance.

3 Design Results

3.1 3 Concepts for the Technological Self-Care Pain Management Service

By using the convenience of intelligent, wearable devices; physiological detection technology; wireless communications; and cloud-based medical care technology, we devised products and information interface designs. Based on the physiological and psychological needs of elderly patients with pain due to chronic illness, we innovated the service design and constructed a series of pain management and service products, which we called “The Pain Project.” The Pain Project includes the following:

(1) Pain Tracker – an integrated, intelligent, pain management ring and automated pain self-mediated medication system.
(2) Pain Helper – an intelligent, prescription patch machine with touch-sensitive patches for pain due to chronic illness.
(3) Pain Exerciser – an interactive, far-infrared, pain and health management device with somatosensory motion instrumentation.

The Pain Tracker. The Pain Tracker is composed of an integrated, intelligent, pain management ring and pain self-mediated medication system. At the onset of pain in an elderly person with chronic illness, the ring measures the sympathetic physiological signals created by the autonomic nervous system. It records the time of the onset of pain, the frequency of pain, and the R-R high- and low-frequency changes. The elderly person can also twist the ring to view a subjective pain index and record a vocal description of the chronic pain symptoms. The information can be transmitted over the cloud to an assisting physician for an accurate evaluation of the pain condition. This combined with the self-medicated medication system can prompt the elderly patient to take pain medications and activate the pain patches, and remind the patient to exercise (Figs. 4 and 5).

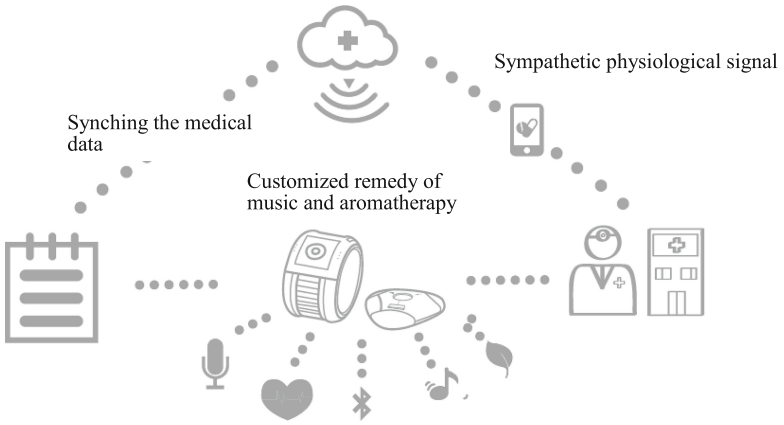

Fig. 4. The *framework of pain tracker service*

The Pain Helper. The Pain Helper is an intelligent, prescription patch machine for pain in chronic illness that is available in pharmacies. It offers intelligent pain-relieving patches to elderly patients with different levels of chronic illness-related pain. When the Pain Helper receives the pain signal from the Pain Tracker, the patient's prescription data is sent over the cloud, and the machine can immediately make an intelligent pain patch tailored to the patient's need. On the screen, it can display relevant health education information. The machine has different built-in pain medications that can be refilled or replaced. When the elderly patient pushes the sensing pad on the intelligent patch, the chronic pain medication is evenly distributed onto the patch and the

Fig. 5. Prototype *of pain tracker*

Fig. 6. The *framework of pain helper service*

time-recording function is activated. This helps the patient use the patch correctly (Figs. 6 and 7).

The Pain Exerciser. *The Pain Exerciser is an intelligent device that offers hand and foot exercises and far-infrared treatment to elderly people with chronic illness-related pain. Through a 3-D floating laser projection technology, it creates images of different sports themes. Paired somatosensory devices on the hands and feet detect posture and control the projected image. It promotes peripheral blood circulation. Combined with far-infrared treatment, it improves the oxygen supply efficiency of the body and the*

Fig. 7. Prototype *of pain helper*

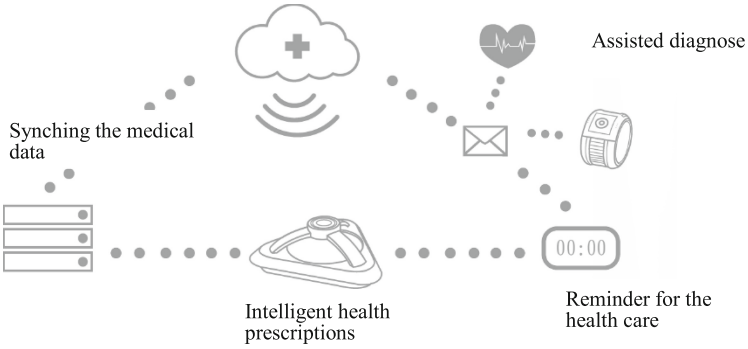

Fig. 8. The *framework of pain exerciser service*

effectiveness of exercise for the treatment of chronic illness-related pain. Relevant exercise data are also simultaneously recorded by the Pain Tracker to provide the physician with auxiliary clinical pain data for diagnosis (Figs. 8 and 9).

This research specifically aimed to emphasize the importance of understanding and managing chronic pain among the elderly. It combined academic research with design practice. Moreover, it supports interdisciplinary design creativity and exemplifies the synergy between the humanities and sciences.

Fig. 9. Prototype *of pain exerciser*

4 Conclusion

This study has demonstrated that older adults will use and can benefit from a relatively technological self-care pain management service that provides easy to use mind-body self-care techniques. Such an intervention may empower older adults in chronic pain to engage in self-care, focus on managing pain in a positive way, and integrate what they learn into their daily routines. Thus, a technological self-care pain management service intervention can be suitable for older adults who have various and multiple health problems. Although this study targeted older adults, such interventions are also amenable for use by adults of younger ages, as the techniques and exercises are not specific to older people. Reaching those in chronic pain can be a challenge, as pain often limits mobility and leads to social isolation and depression, thereby undermining motivation to engage in self-care or attend educational sessions. Those who are unwilling or unable to set to hospital or who are reluctant to learn techniques in a group setting may especially appreciate the convenience and privacy of technological self-care pain management service. Offering mind-body self-care techniques via the technology is a promising strategy for complementing medical care and insight medication for older adults and others in chronic pain.

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