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A Study on Smart Medical Product Service System for the Elderly With Chronic Disease at Home

재택 만성질환 노인을 위한 스마트 의료제품 서비스 시스템 연구

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Abstract

This study aims to improve the service quality and management level of smart medical products for the in-home elderly with chronic diseases. Based on the existing health and elderly care products, services related to the products are added to build a sustainable intelligent medical product service system for the in-home elderly with chronic diseases, consisting of intelligent elderly care products, health services and support facilities. Adopting the product service system theory, the current situation of self-management and health service needs of the elderly with chronic diseases in china were investigated through stakeholder analysis, user interviews and role models. Combined with the KJ method, the problem points and needs were classified, a strategy was proposed to extend the value of the smart medical product service system for the elderly with chronic diseases. Results can be used to solve the contradiction between the demand and supply of medical and health services for the in-home elderly with chronic diseases, to promote the healthy, orderly and sustainable development of the in-home elderly services, and improve the living quality of the chronically ill elderly in their old age.

Keyword

The Elderly With Chronic Diseases(만성질환 노인); Smart Medicine(스마트 의료제품); Service Design(서비스 디자인); PSS

요약

본 연구는 만성질환 재택 노인을 위한 스마트 의료제품의 서비스 품질 및 관리 수준을 향상시키는 것을 목적으로 한다. 기존의 건강노인 의료제품에 관련 서비스를 추가하여 스마트 노인의료제품, 건강서비스, 지원시설 등으로 구성된 만성질환 재택 노인을 위한 지속 가능한 스마트 의료제품 서비스 체계를 구축한다. 제품 서비스 시스템 이론을 채택하여 이해관계자 분석, 사용자 인터뷰, 역할 모델을 통해 중국 내 만성질환 노인의 자기관리 및 건강서비스 니즈 실태를 조사하였다. KJ 기법을 결합하여 문제점과 니즈를 분류하고, 만성질환 노인을 위한 스마트 의료제품 서비스 시스템의 가치를 확장하기 위한 전략을 제시하였다. 결과는 재택 노인 서비스의 건강하고 질서 있고 지속 가능한 발전을 촉진하고 삶의 질을 향상시키기 위해 만성질환이 있는 재택 노인을 위한 의료 및 건강서비스의 수요와 공급 사이의 모순을 해결하는 데 사용될 수 있다.

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1. Introduction

On May 11, 2021, the results of China's Seventh National Population Census showed[1] that the total population aged 60 and above was 264.02 million, accounting for 18.70% of the total population, of which 190.64 million were aged 65 and over, accounting for 13.50% of the total population. The degree of population aging has further deepened[2]. China will enter a deep aging society in 2027[3], when the proportion of the elderly over 65 years old will be more than 15%. At the same time, according to the statistics of the National Health Commission[4], the health status of the elderly in China is not optimistic. The cognitive, motor sensory functions decline with the increase in age, and nutrition[5], psychological and other health problems are becoming increasingly prominent. More than 78% of the elderly suffer from at least one chronic disease, and the number of the disabled elderly continues to increase[6].

For such a large group of elderly chronic diseases, if they are hospitalized for a long time, they not only need to consume a lot of medical resources, but also the high medical cost is an unbearable burden for most families. Therefore, the treatment of elderly chronic diseases mainly depends on the patients' own independent management and self-prevention in daily life[7]. Chinese people tend to choose home-based elderly care. According to relevant research, 90% of the elderly chose home-based elderly care, and only about 10% of the elderly chose institutional elderly care. In this case, for the large number of the elderly patients with chronic diseases with long cycle, high cost and great demand, how the government, communities and pension institutions extend the nursing services to the elderly with chronic diseases so as to provide targeted nursing for them, and meet their needs for socialized pension services, is a practical problem that must be solved.

At present, smart medical products[8] based on Internet of things, big data, cloud computing and other technologies use smart watches or other portable devices to instantly monitor blood pressure, heart rate, blood glucose, ECG and other vital signs[9], which are automatically transmitted to the management APP through the Internet. The elderly or their care givers view various data on the mobile phones, which improves the detection rate of patients with chronic diseases and controls the progress of the

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disease to a certain extent, thereby, accelerating the recovery of the body. However, such products tend to be similar in structure and function, mainly providing daily health monitoring, one-click call and voice-call services, lacking scene experience, ignoring the individual differences and personalized needs of service supply, and there is a mismatch between supply and demand. At the same time, the participation of social forces is not high, and there is a lack of professional elderly care operations and service teams.

PSS (Product Service System) is a system[10] that includes products, services, networks and support facilities. Through the integration of products and services, the full participation of customers, and the mutual provision of productive services and service production by enterprises, we can realize the integration of decentralized manufacturing resources and the high synergy of their core competitiveness, and achieve an efficient and innovative manufacturing mode[11]. At present, there are many researches on the elderly care service mode[12], elderly care service facilities[13] and aging adaptation transformation design[14] related to the health of the elderly, and there are few researches on the market-oriented combination with elderly care products and services to jointly meet the needs of users. Therefore, this paper takes the home-based elderly with chronic diseases over 65 years old in china (not living with their children) as the research object. On the basis of understanding the medical service needs of the elderly with chronic diseases, it plans to integrate tangible health smart products and intangible elderly care services, and build a smart medical service system for the in home elderly with chronic diseases.

2. Process and Methods

The process method[15] of PSS is used and the design of smart medical product service system for the in-home elderly with chronic diseases is divided into four steps: first, conduct in-depth research on the current situation. Second, identify the problems that the in-home elderly with chronic diseases are most concerned about and need to be solved at present. Third, find potential solutions. Fourth, promote the service to the market according to the content validity ratio evaluation and feedback mechanism. The specific contents and methods are as follows.

2-1. Situational interview

Eight communities (high, middle and low-grade communities, unit family areas, demolition and resettlement communities, etc.) in Changchun City, Jilin Province were selected to conduct situational interviews with patients with chronic diseases aged over 65 years old. The duration is 20 minutes -1 hour for each person.

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The interview time is from February 10, 2022 to February 28, 2022. First of all, the interviewer introduced the purpose of the interview, the operation of the process and the possible situation, promised information security and asked whether it could be recorded[16]. After obtaining consent, the interviewer asked questions in the form of a semi-structured questionnaire about the overall life, target behavior, emotional health, the use of smart medical products and other aspects of the elderly, to understand the different moods, behaviors and needs of patients with chronic diseases in the home-based elderly care environment, During the interview, the interviewer shared his interpretation and assumptions with the interviewees to obtain timely verification and deepen the dialogue. Finally, the interviewer gave a gift to the interviewee to express appreciation.

2-2. User Role Persona and User Journey Map

Through the user situation interview in the early stage, a large number of real and effective data are obtained, and then the target users of the product are classified and the user role model[17] is created. As shown in Figure 1, the x-axis represents the level of mental health, and the y-axis represents the level of chronic diseases. Patients with chronic diseases in home-based elderly care are divided into four types: A, B, C and D. A represents the elderly with stable conditions, calm and open-minded; B stands for the elderly with occasional small fluctuations in their condition, no obvious discomfort and danger, and low mood; C stands for the elderly who are in unstable condition, prone to emergencies and have large emotional fluctuations; D stands for the elderly who are in stable condition but depressed and pessimistic. In order to make the product design more focused, this study selects the Type-C elderly, that is, the elderly who are in unstable condition, prone to emergencies, and have large emotional fluctuations as the core users.

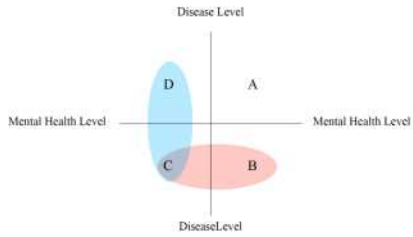

Figure 1. Subdivision types of in-home elderly people with chronic diseases

Two user roles were created for service scenario development, and the user journey maps were drawn based on the physical condition, lifestyle, behavior habits and existing health management methods of the in-home elderly with chronic diseases, so as to clearly understand the thoughts and feelings of the elderly and the description of pain point and pleasure point so as to make decisions more effective, as shown in Figure 2 and Figure 3.

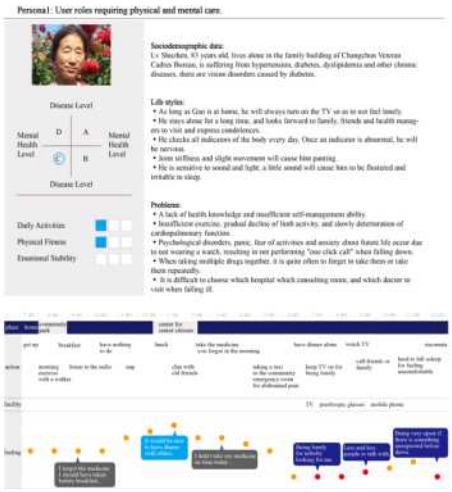

Figure 2. Persona 1. User roles requiring physical and mental care

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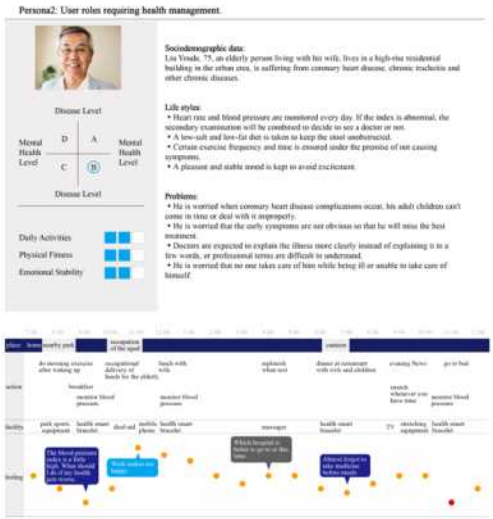

Figure 3. Persona 2. User roles requiring health management

2-3. Definition of problems

A total of 103 descriptions of health service needs, willingness and confusion of the in-home elderly with chronic diseases and 420 valid questionnaires[18] were collected in this survey. The study used the KJ method to sort out and classify the collected information according to the relationship[19], and finally defined the health services for the in-home elderly with chronic diseases as problems in 8 categories, as shown in Figure 4, which are difficulty in seeing doctor, Lacking medical and health care knowledge, improper medication management, confusion about diet and nutrition, decline in physical function, mental health, anxiety and fear in case of trouble, and nursing confusion.

Figure 4. KJ Analysis

As shown in Figure 5, the points of the logical relationship are connected with a straight line, using arrow symbols to represent the cause-effect relationship, and then find the core problem factors[20].

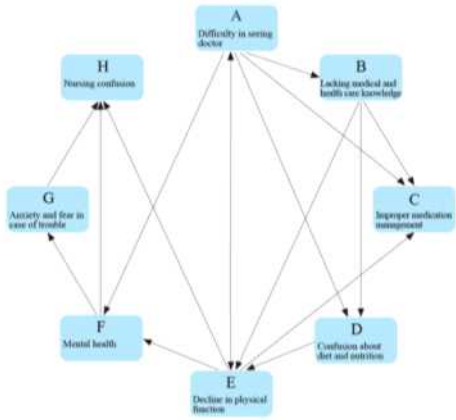

Figure 5. Association Graph

As shown in Figure 6, through the interpretation of the intersection points in the matrix diagram, we can understand the degree of correlation between the categories. According

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to the formula, the values of the X and Y axes are obtained. Substituting the values into the coordinate graph can clearly see that the categories above 0 point in descending order are: A, B, G, F and E.

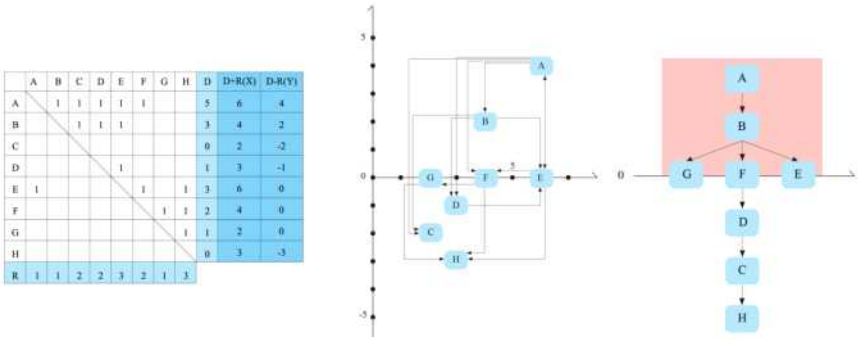

Figure 6. Matrix Diagram

2-4. Solutions

According to the core issues of home-based care for the elderly with chronic diseases, based on the existing health smart products and APP applications, organizational coverage and service extension are expanded so as to strengthen facility construction and build a smart medical service system for the in-home elderly with chronic diseases. The design content is shown in Table 1:

Table 1. Smart medical service design content.

Problems	Solution	Details
A. Difficulty in seeing doctor	Assist in medical treatment	1) The attendants plan and arrange the treatment process, help the elderly easily complete the treatment, and receive and send the report on behalf of the elderly. 2) The attendants help the elderly accurately describe the condition to the doctor, and express the doctor's orders to the elderly in simple words.
B. Lacking medical and health care knowledge	Health education	1) Send medical and health knowledge according to user needs and physical characteristics. 2) Organize question-answering competitions to mobilize the enthusiasm of the elderly with chronic diseases to accept and actively learn health knowledge.
G. Anxiety and fear in case of trouble	Health management	1) For the elderly with depression after psychological evaluation, the psychologist will come to the door to provide psychological counseling and psychological support. 2) Provide catering, cleaning, walking, purchasing, life care and other services 3) Monitor and record blood pressure, heart rate, pulse, sleep quality and other indicators in real time, and conduct safety monitoring (remote monitoring, SOS alarm system, audible and visual alarm, etc.)
F. Mental health	Culture entertainment	1) Provide social and entertainment platforms so that the elderly can play mahjong, play chess, listen to opera, watch movies, dance square dance, etc. 2) Carry out outdoor activities such as visiting museums, art galleries and scenic spots, and staff provide vehicles, guided tours and explanation services for the elderly. 3) The elderly who are willing to work and have physical conditions can find suitable jobs according to their actual situation.
E. Decline in physical	Health care	1) Formulate a rehabilitation plan

function		according to the characteristics of patients and medical history, and resume the course according to the video teaching practice. The doctor monitors the rehabilitation situation in real time and gives guidance and correction. 2) Make an appointment with offline sports rehabilitation training courses, venues through APP. 3) Send information about digital training or puzzle training to improve the intelligence of the elderly; Play their favorite music, promote the recovery of memory, etc.

3. Construction of a smart medical service system for the in-home elderly with chronic diseases

3-1. Business Model Canvas

Based on the above research results, the nine modules of the business model canvas are adopted to build the business model canvas of the smart medical service system for the in-home elderly with chronic diseases in order as shown in Figure 7. This model standardize the elements in the business model, emphasize the interaction between the elements, and establish a visual business model so as to provide enterprises with overall decision-making solutions to ensure that the target users are correct; thus, the problems can be reasonably solved, and ultimately improve revenue and efficiency.

3-2. Service Scenario

As shown in Figure 8, Based on the commercial model canvas of the smart medical service system of the home-based elderly with chronic disease, the smart medical service scenario for the in-home elderly with chronic diseases are drawn, which shows the detailed process of the smart medical service system of the in-home elderly with chronic diseases.

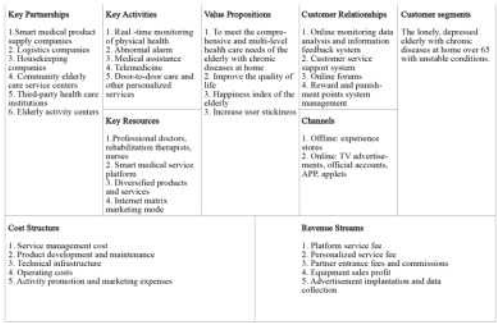

Figure 7. Business model canvas of the smart medical service system for the in-home elderly with chronic diseases

4. Discussions

It is found that due to the increasing demands for elderly care[21], medical services[22], activity desire[23] and spiritual care, the contradiction between the growing material, survival and spiritual needs of the elderly and the unbalanced and insufficient supply of elderly care services has become the main contradiction restricting the development of elderly care services and industries[24]. It is difficult for the product concept, channel mode and sales mode of traditional pension products to solve the current pension problems. It is urgent to optimize the elderly care service product system

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Figure 8. Smart medical service scenario for the in-home elderly with chronic diseases

and innovate the elderly care service mode, which is the first choice to solve the problem of population aging[25]. Therefore, this study starts from the health management needs of the in-home elderly with chronic diseases, relies on the Internet big data information integration technology. Through the joint participation of stake holders and collaborative upgrading of the smart medical service system for the in-home elderly with chronic diseases, we can improve the utilization rate of social health care resources for the elderly, promote the adjustment of the industrial structure of health care for the elderly, increase the interaction between patients and medical personnel, medical institutions, medical equipment, and achieve the goals of a sense of security, a sense of medical care, a sense of productive aging, a sense of learning, a sense of happiness and a sense of being at ease in old age for the elderly.

Our study has confirmed the great development potential of smart elderly care products[26][27]. Most elderly people with chronic diseases have a positive attitude towards smart elderly care products[28], but some elderly people

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have a weak knowledge foundation and need to learn to use digital tools from family members. Most adult children who are the only-child in the family in China are busy with work, so it is difficult for them to take a time to explain them in detail for the in-home elderly. The age difference between two generations will also lead to children not knowing much about the receptivity of the elderly. In addition, if the teaching method is wrong, the elderly will also have a vague understanding of digital tools, and even have the fear of difficulties[29]. Therefore, it is necessary to gather the elderly in the community through online and offline training to help them learn to use the smart medical service system, provide them with an environment for communication and mutual learning, and fully mobilize their learning enthusiasm.

Some elderly people with chronic diseases who participated in the survey said that although they can chat with their family and friends by phone and online video, they prefer face-to-face conversation, which will make them feel more natural, cordial and authentic. And a lot of information is conveyed by nonverbal signals, such as the rhythm and tone of voice, gestures, and the distance between communicators, which can only be achieved in face-to-face conversation. Although many communities carry out spiritual care services to alleviate the mental loneliness of the in-home elderly with chronic diseases, such as chatting with the elderly, reading newspapers for the elderly, etc. the elderly generally express their unwillingness to bother others, which is consistent with the research results of sociologists[30]. With the growth of age, the elderly's sense of dependence will gradually increase[31]. At the same time, their sense of inferiority will also increase day by day. A deliberate way may easily make them to feel that they are a weak grou p[32].

The future work can focus on the satisfaction of the elderly with chronic diseases and service personnel with the use of smart medical products, further refine the different design needs caused by the differences of the elderly with chronic diseases according to the different stages of patients with chronic diseases (such as the six natural disease course stages of no danger stage, the emergence of risk factors, the emergence of pathogenic factors, the emergence of symptoms, the emergence of signs, and the loss of labor), correspond to different operation strategies, and study how to improve the efficiency of private domain operation.

5. Conclusions

The intelligentized, integrated and all-round smart medical service system for the in-home elderly with chronic diseases established in this study aims to achieve the accurate matching of the elderly care demand and supply of the elderly with chronic diseases, and provide the elderly with all-round and whole process elderly care services. The data collected in the service system, through sorting and data mining, can

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provide support for relevant government departments to formulate pension policies and resource integration and allocation, such as scientifically standardizing market access, talent team, smart equipment, platform construction, service level and other standards, so as to promote the better and faster development of smart pension.

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