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Research article

A novel "five-in-one" comprehensive medical care framework for rehabilitation and nursing

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Abstract: With the evolution of society, the world has entered a moderate stage of aging. Not surprisingly, the aging problem in the world is getting more intense, resulting in the increasing demand for higher-quality and well-organized medical and elderly care services. To cope with that, many researchers have dedicated themselves to advancing the medical care system based on data or platforms. However, they have ignored the life cycle, health service and management and the inevitable shift of living scenarios for the elderly. Therefore, the study aims to improve health conditions and enhance senior citizens' life quality and happiness index. In this paper, we build a unified body for people in their old age, bridging the disconnection between medical care and elderly care and constructing the "five-in-one" comprehensive medical care framework. It should be mentioned that the system takes the human life cycle as its axis, relies on the supply side and supply chain management, integrates medicine, industry, literature and science as methods, and takes health service management as a requirement. Furthermore, a case study on upper limb rehabilitation is elaborated along the "five-in-one" comprehensive medical care framework to confirm the effectiveness of the novel system.

Keywords: supply side; supply chain management; health service and management; "five-in-one"; comprehensive medical care framework

1. Introduction

Recently, the aging phenomena in the world has been intensifying, accompanying more and more social issues, especially the care for disabled elderly [1]. According to the population census of the world and related statistical data, the aging population has posed a grand challenge to home healthcare [2, 3]. At the same time, the demographic structure has altered and the proportion of older

people has soared, highlighting the concern about high-quality elderly care. To empower the process, the care services have integrated a plethora of advanced technologies, such as supply chain, big data and cloud computing [4–7].

As for the elderly care model in the world, it largely goes through five stages, which are home care, centralized care (ordinary senior center), centralized health care (nursing home), intelligent health care (digital intelligent rehabilitation center), the integrated medical and health care system, etc. It should be mentioned that the need for medical care was introduced into the elderly care system from "centralized health care" [8], which evolved into what is currently known as the "medical and health care system". Moreover, the "medical and health care system" is built on continuous adaptation to the social and economic development and the multiple requirements of the elderly. However, the existing "medical and health care system" is still far from achieving "health services and management" for the elderly. Also, the disconnect between medical needs and health care is still to be solved [9, 10]. Therefore, it is rather urgent to propose multi-level retirement and medical care solutions to improve the health condition of the elderly and enhance the quality of their life.

Due to the above deficiencies, health services and management [11], which refers to the monitoring, analysis and intervention of the whole process of a person's health status and the fulfillment of medical and service requirements at the health level in various methods, is first introduced to enhance the quality of service. Furthermore, we usher in the integration of medical and engineering sciences as well as the integration of literature and sciences and take them as the guidelines of the novel system. The first integration can be viewed as a process where engineering approaches are applied to solve medical treatment difficulties, simplify medical therapy procedures and provide prevention. Similarly, the second integration is defined as a process where art, psychology and sociology methods are applied to solve medical treatment difficulties, simplify medical therapy procedures and provide prevention. Besides, the integration of medical care and elderly care [12], a process where medical and elderly care resources are united to maximize the utilization of social resources, is adopted to guarantee the health support system.

The manuscript is composed as follows: Section 2 reviews the limitation and advancements of relevant studies, and Section 3 details the construction of the novel "five-in-one" comprehensive medical care framework. In Section 4, a case study related to upper limb rehabilitation for five scenarios is presented to validate the effectiveness of the proposed framework. Finally, Section 5 draws a concise conclusion in terms of the benefits of the "five-in-one" framework and outlook for prosperous elderly care.

2. Related works

2.1. Limitations of previous studies

In recent years, many scholars from diverse areas have studied healthcare issues. Accordingly, they put forward many solutions for existing health care systems from the perspective of technology, management, methods, and strategies [13–15]. However, given the state of elderly care in the world, it can be easily concluded that there are multiple limitations in previous systems and solutions. Furthermore, these limitations can be categorized into linkage and systemic bottlenecks based on whether to associate with other segments, as shown in Figure 1. Most of these research studies have not considered multiple medical phases as one whole procedure. This may be a huge burden for parts

of the care system, such as hospitals. As it is shown in Figure 1, the previous research involved irregular daily medical management without a system administrator of the care system. The incomplete data analysis of the human body may lead to a misdiagnosis and misuse of medical procedures. Furthermore, the insufficient data sharing among different medical phases also confuse the doctor and the patients during the recovery procedure. Hence, a novel medical care framework should be proposed to overcome these limitations. The construction of the novel "five-in-one" comprehensive medical care framework in this paper integrates intelligent diagnosis, medical management, and data sharing, aiming to overcome the above limitations.

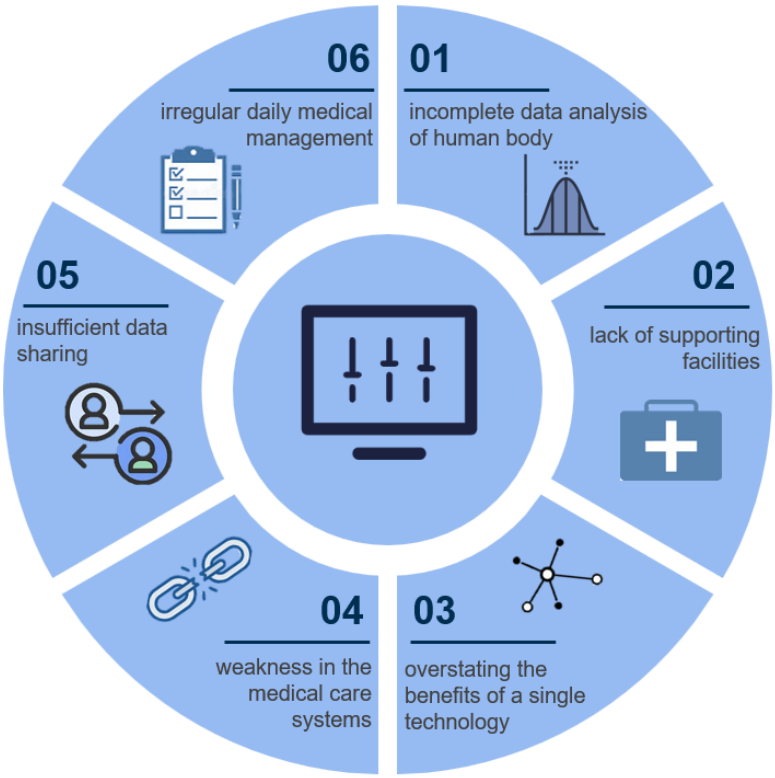


Figure 1. Limitations of previous studies on healthcare system.

The initial three problems stem from each linkage, and the last three problems originate from loose connections among links. First, the human body's data analysis is incomplete, resulting in a widespread phenomenon of exaggerating minor illnesses and prolonged hospitalization. Consequently, patients with serious diseases are delayed in receiving timely treatment, leading to the deterioration of the condition. On the other hand, greater tension in the resources of the large hospitals is created. Second, the lack of supporting facilities [16] in the medical service system has weakened people's trust in the pension plan, leading to many unoccupied nursing beds. Due to inadequate support facilities, patients and their family members lose confidence in the elderly care system and are unwilling to rely on its services. Third, the system overemphasizes the benefits of a single technology, thereby ignoring the significance of technology integration and functional collaboration. People with considerable distinction are the main subject of the health care system, and the living scenarios are

diverse and intricate, so a single technology cannot satisfy multiple requirements.

Fourth, the existing medical and elderly care systems are mainly targeted at individuals but are weak in integrity [17]. According to the status of research, the present technologies are being developed from the perspective of a specific link rather than the overall system. Therefore, there are many service loopholes left due to ill consideration. Fifth, in the medical care system, the data sharing of caring, nursing, health care and cured information is insufficient [18], and the information among these entities is blocked, which makes medical treatment, daily nursing and systematic rehabilitation fall into a disordered state. Sixth, daily medical management is irregular, as monitoring patients who have been released from the hospital is a blind spot [19]. In general, once the patient's symptoms improve, they will quit taking medicine or treatment, thus resulting in recurrent episodes of the patient's condition and repeated medical treatment, which is a waste of various resources.

2.2. Research advancements

Many researchers have dedicated their efforts to this field to cope with the problems above. In general, related studies can be classified into two types in accordance with different research objects, which are the data and platform.

Studies taking data as its research object refer to collecting, digesting and feeding back relevant information by using technical tools, decision-making methods and management tools [20,21]. Internet of Things (IoT)-based medical care system that was built on wireless sensor networks could provide doctors, guardians or family members with health condition information, which could facilitate the monitoring of people's physiological conditions. However, to prevent leakage of privacy, an advanced data encryption and secure authentication scheme for IoT-based telemedicine systems was proposed by Li et al. [22]. The novel scheme could achieve user anonymity and prevent the security threats of password/sensed data disclosure. The wireless body area network (WBAN) is a set of body sensors carried by the users, and it is revolutionary in many application fields, varying from remote patient supervision, sports performance monitoring, and elderly healthcare monitoring [23, 24]. Based on the WBAN, Li et al. [25] proposed a secure cloud-assisted architecture for accessing and monitoring health items without exposing sensitive medical data. Chen et al. [26] proposed an IoT-based medical monitoring system for rural areas that were used to stockpile and process related data. In the case of wearable physiological sensing devices, much sensing data from people with chronic diseases or those who require long-term monitoring will be transmitted to rural medical vehicles so that doctors can accurately diagnose symptoms [27].

Some scholars have also taken the platform as a research object. Yang et al. [28] developed a network information security platform for the elderly's health where "integration of physical, medical, and nursing care" was achieved. The platform comprises five modules: health records, follow-up plans, remote training, health education and remote consultation. According to actual needs, some modules are also subdivided further. Moreover, the overall effect of the platform received compliments from 13 users. Xu and Zhang [29] improved an innovative senior care service platform by employing grey relational analysis and fuzzy-quality function development. The technical advancement not only enhanced the market competitiveness of senior care service products , but it also catered to the needs of senior citizens. Wang and Xu [30] constructed the "Internet Plus" Community Smart Elderly Care Service Platform. To fulfill the completeness, scientificity and versatility of the elderly care model, Wang and Xu tried to integrate the Internet, IoT, mobile

networks, big data and cloud computing and apply them to community elderly care services. In this way, the limitation of time and space was eliminated and the cost burden for families was cut. When it comes to applications in hospitals, Haghi et al. [31] created a configurable and adaptable platform for medical use, mainly for parameter monitoring. In the platform, real-time communication between the end users and physicians is available through the IoT gateway connected with wearables.

According to the aforementioned works, whether the research is data-based or platform-based, these two kinds of research have pushed the original elderly care model toward a more complete medical and health care model, facilitating the integration of medicine and health care. However, there is a lack of overall consideration of the "health services and management" along the "life cycle" [32] as well as a lack of consideration of the links among the changing residential scenarios of older people in their later years [33]. To fill these research gaps, we have constructed a "five-in-one" comprehensive medical care framework, which underlines the continuity of rehabilitation and care, thus maintaining service quality only with minimum resources.

3. Construction of a novel comprehensive medical care framework

Given the problems in ordinary medical care systems, we designed a novel "five-in-one" comprehensive medical care framework based on integrated medical and engineering sciences. The term "five" refers to five scenes: home, centralized home (senior center), nursing home, rehabilitation center and hospital, which are the living scenarios of seniors in their later years. The term "one" indicates integrating the five scenes by using medical-industrial, cultural and scientific technologies. Additionally, the elderly will be cared for under health monitoring, analysis, management and intervention. Therefore, it will be more conducive to the health service of the elderly.

The design of the novel "five-in-one" comprehensive medical care framework is generally split into two parts. The first part is the construction of a five-in-one living scenario, and the second is the construction of a health monitoring, analysis, management and intervention system, as well as system support platforms.

3.1. Construction of a five-in-one living scenario

Based on supply-side theory [34] and supply chain management methods, the design divides the routine living scenarios of the elderly into five portions by using medical mathematical and statistical methods: home, centralized home (senior center), nursing home, rehabilitation center and hospital [35]. Thereafter, we built a dedicated private cloud to virtually integrate the five-unit scenes, thus forming a supply chain service system (Figure 2).

The system centered on a "five-in-one" supply chain is guided by the "integration of medicine and engineering sciences " and "integration of literature and science", and it is built on integrated technology, which is distinct from the previous health care and elderly care models. Moreover, the intention is to fill the gap in the existing solutions for the integration of medical treatment and elderly support and then provide a full range of medical prevention treatment and elderly care services.

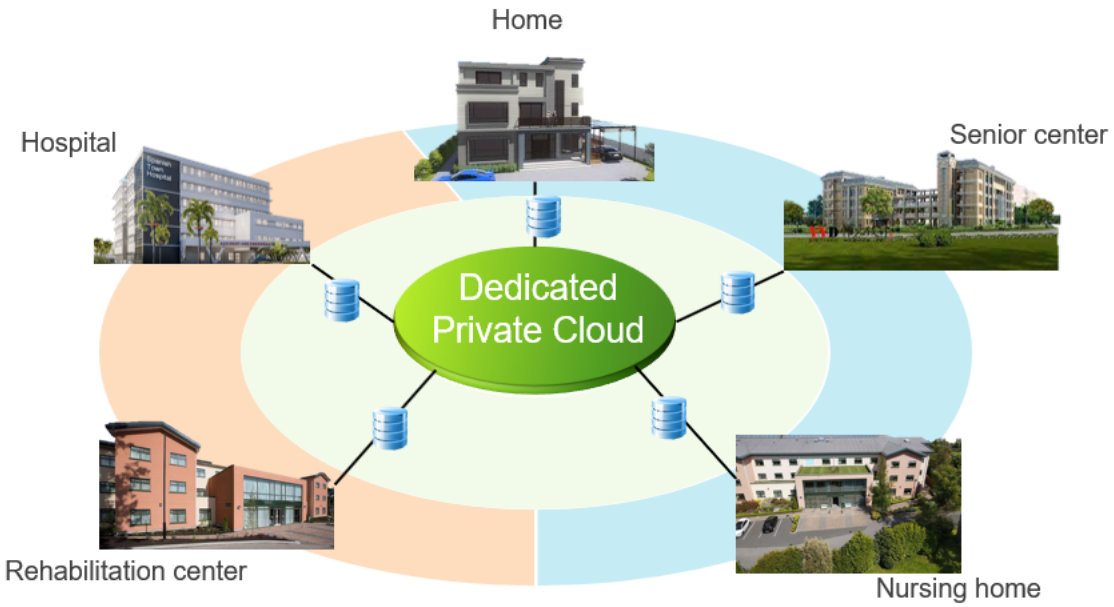


Figure 2. Interrelationships of five units in comprehensive medical care framework.

In this comprehensive medical care framework, the five main modules are expected to work in synergy with each other, with the following interrelationships: A represents the number of people at home; B represents the number of people in senior centers; C represents the number of people in nursing homes; D represents the number of people in rehabilitation centers; E represents the number of people in hospitals; η represents the number of deaths from receiving invalid treatment at hospitals; the upper-case letters from a to l are coefficients, and the specific numbers for C, D and E can be calculated as follows:

$$\begin{aligned} C &= A \times \mathrm{a} + B \times b + D \times \mathrm{c} \\ D &= E \times e \\ E &= A \times \mathrm{h} + B \times j + C \times k + D \times l \end{aligned} \tag{3.1}$$

The final relationship is

$$C \times (1-k) + D \times (1-c-k) + E \times (1-e) + \eta = A \times (a+h) + B \times (b+j) \tag{3.2}$$

The numbers of A and B vary from region to region and depend on the specific construction situation. The coefficients from a to l are determined by a comprehensive evaluation of regional development, consumption levels and overall physical quality.

3.2. Construction of a health monitoring, analysis, management and intervention system

Based on the construction of the five-in-one living scenario, the original separate health management is transformed into a health monitoring, analysis, management and intervention system, which takes the life cycle as its axis and "health service and management" as its leading philosophy. Simultaneously, eight platforms are built, incorporating the ideas of "medical-industrial integration" and "literary-scientific integration" to realize health monitoring, analysis, management and intervention. Moreover, the engineering, literary, and sociological approaches are fully demonstrated to fulfill the medical requirements, such as those related to the physical state measurement and psychological intervention [36, 37].

3.2.1. Components of system

The whole system comprises health monitoring systems for the elderly, data analysis, disposal systems and hardware and software equipment such as sensors and servers that support the functions mentioned. In the whole system, the front-end monitoring system, middle-end data analysis system and disposal system complement each other to achieve a comprehensive integration of "five-in-one", effectively supporting the collaborative operation and closed-loop management of the entire medical and health care supply chain (Figure 3).

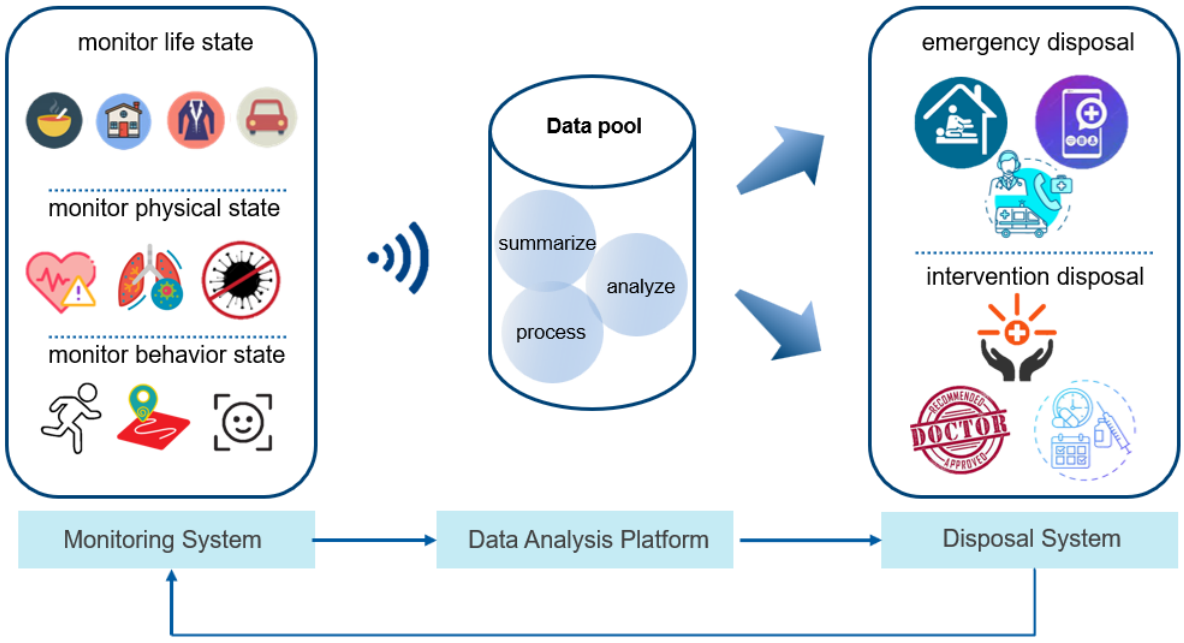


Figure 3. Structural diagram of comprehensive medical care framework.

In this system, the monitoring system mainly incorporates the monitoring of people's state, such as the life state, physical state and behavior state. As for collecting relevant signals and information, it is mainly through various smart wearable devices, monitoring and recording the history of diagnosis and treatment. Specifically, the main method is to connect the main control chip to the data acquisition conversion circuit, the audio conversion circuit, the video conversion circuit, the network

communication circuit and the operation panel, respectively. Moreover, different correspondent interfaces have different conversion circuits. In this way, it can effectively combine various monitoring equipment, carry out unified processing and realize all-day monitoring of the elderly.

The data analysis platform will be built on the basis of the health data center. The health data center will establish a database of common geriatric diseases, which will contain common geriatric diseases, their corresponding symptoms and their respective monitoring risk thresholds. Then, the data analysis platform summarizes, analyzes and processes the collected relevant information and images and compares the obtained data results with the health control pre-warning values set in the geriatrics database to decide whether to activate the disposal system.

The disposal system consists of two modules: emergency disposal and intervention disposal. The system is automatically linked to the corresponding module in light of the risk level derived from the data analysis module. In the corresponding module, the system is further linked to the corresponding sub-system in terms of the required help and services. On the one hand, the emergency disposal module incorporates the service system (including home service and remote service) and the medical system (mainly referring to medical assistance). On the other hand, the intervention disposal module consists of the diagnosis and treatment system (such as hospital recommendation and affiliated doctor recommendation), telemedicine (referring to remote diagnosis and treatment distribution, docking foreign industry experts) and a treatment system (providing a complete set of treatment plans). Considering blind spots or delayed supervision by guardians, the disposal module will transmit the information to the family members and the relevant service system while giving a warning alarm. Meanwhile, a disposal response period will be set. If the family member does not respond within the period, the service system will be activated immediately to provide a responsive plan and deal with the situation accordingly.

3.2.2. Eight platforms

In order to effectively integrate the five main bodies and the resources allocated by the system and form an effective medical care system, we will establish eight platforms to support the operation of the system, as shown in Figure 4.

It can be seen that the eight platforms refer to the following: a comprehensive management platform for the status of care recipients (mainly for real-time dynamic monitoring and analysis); hardware facilities standards and configuration of the medical care framework (including hardware facility in various institutions); a platform for the collection of status data on people being cared for in the healthcare system (through wearable medical devices, portable handheld input devices and behavior monitoring devices, etc.); the physical state and physical regulation of care recipients in the medical care framework (including methods and standards for artificial state interference such as molecular-level disease diagnosis, cell therapy and drug interference); the construction and standards of an emergency countermeasure platform in the medical care process (including emergency measures such as automatic alarms, automatic calls for help and automatic disposal); platform construction and standards for data aggregation, analysis and identification in the medical care framework (mainly for data aggregation, storage, analysis and identification); the construction and standards of a family ease platform in the medical care framework (family members can check the status of the care recipient in real-time) and application platform of psychology, nutrition and energy medicine in the medical care framework (mainly through physical and chemical interventions).

Based on the aforementioned research, we finally combine the system and the platforms into one and run it as a whole. The system and platforms are then applied to the elderly care in the "five-in-one" supply chain system, forming a complete health service and management system. It can simultaneously manage shifts in the elderly's living scenarios and physical condition, thus addressing the challenge of separation between elderly care and medical prevention. When it comes to managing people's health, we regard the five scenarios as one system. In contrast, when it comes to grading health states or medical interventions for health conditions, we consider the five scenarios as five systems. By organically combining the single need for old-age provision with the need for a medical care and scenario shift, medical and health care unity that integrates medical, engineering, liberal and science technology is formed, namely the "five-in-one" comprehensive medical care framework.

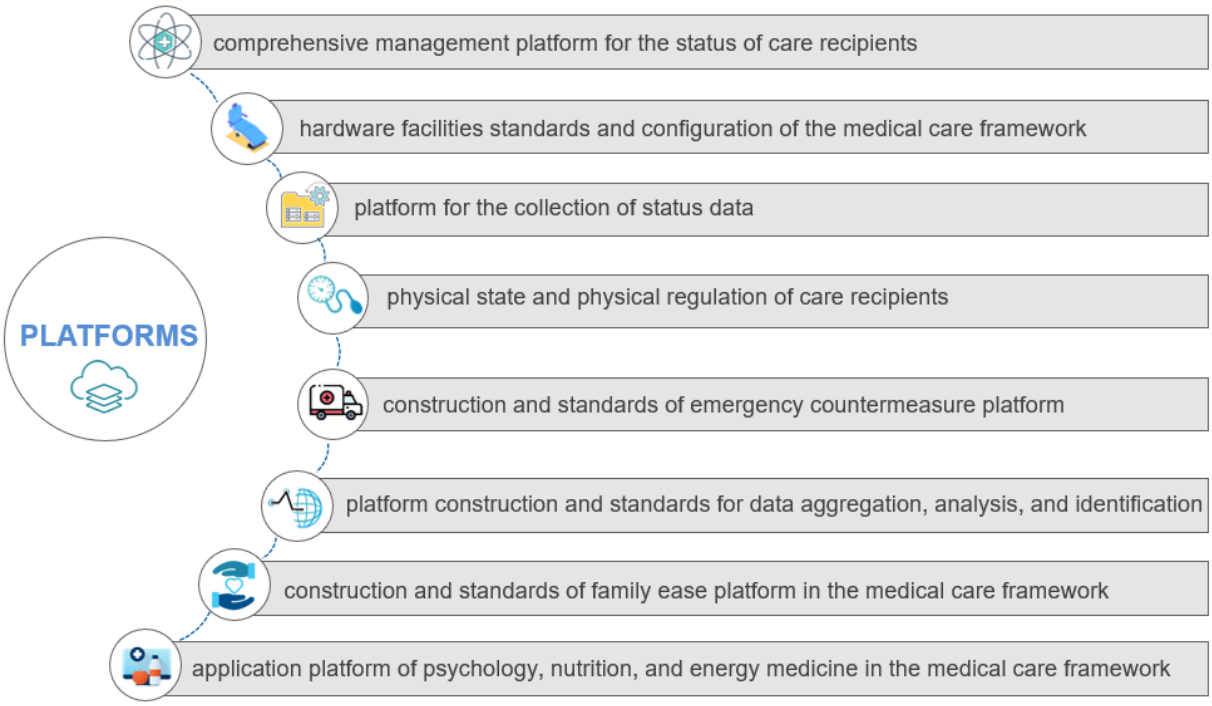


Figure 4. Platforms of the comprehensive medical care framework.

3.3. Main advantages of the "five-in-one" comprehensive medical care framework

Compared with existing health care systems, the "five-in-one" comprehensive health care system possesses the following features and advantages (Figure 5):

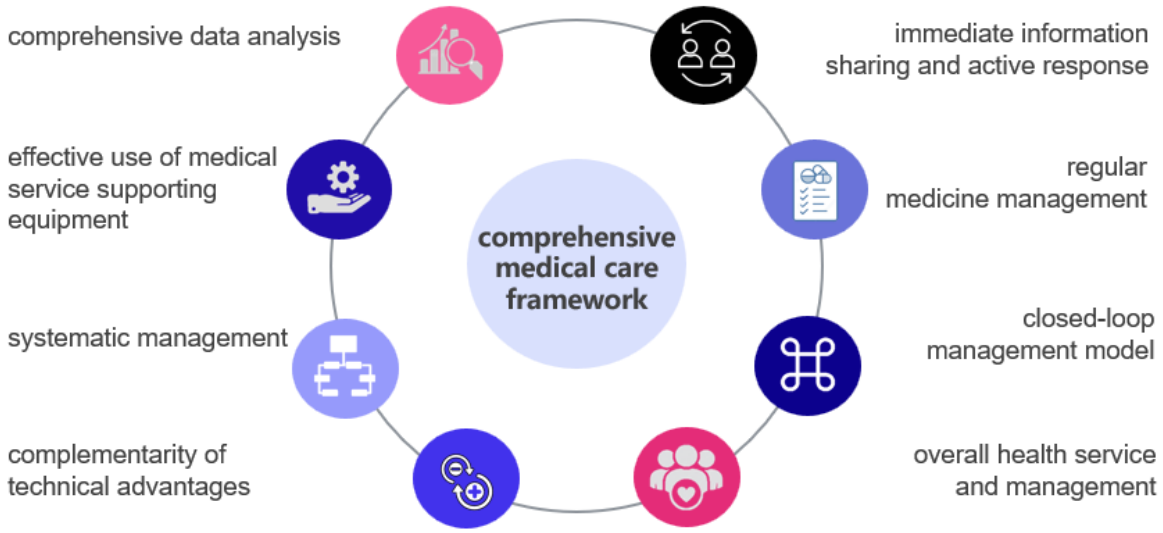


Figure 5. Advantages of "five-in-one" comprehensive medical care framework.

First, the diversification of data sources enhances the comprehensiveness of data analysis: Through the multi-channel monitoring of the care recipients' life status, physical status and behavior status, all-around signal acquisition is carried out to support the complete data extraction.

Second, the effective use of medical service-supporting equipment is attained: Based on a rational analysis of the prevalence of various geriatric diseases and the data on self-care, basic self-care and total incapacity for self-care among all old-age groups, the Computerized Numerical Control Center can scientifically allocate real resources to ensure the rationalization, intensification and efficiency of the supply of pension resources.

Third, systematic management is highlighted: It facilitates the merging and optimization of resources from many parties, opens up their intrinsic linkages and reduces the workload of families, elderly practitioners and medical staff.

Fourth, the complementarity of technical advantages is achieved: A systematic solution for home care, elderly care institutions and community care is provided, making up for the inadequacy of the current single service. At the same time, clothing, food, housing and transport are involved, ensuring the safety of the elderly in their travel and life.

Fifth, realization of the immediate information sharing and the active response between the guardian and the service subject: On the basis of networked elderly care services, the information-based big data platform is built to optimize the construction of the medical and health care service system. Apart from information sharing, information response speed and efficiency are emphasized particularly.

Sixth, the realization of regular management of medicine: By forming a set of regular management systems of medicine containing post-hospital rehabilitation, the problem of recurrent episodes and the repeated medical treatment of patients caused by inadequate monitoring and management after release from the hospital can be solved.

Seventh, a closed-loop management model integrating daily medical management, nursing,

medical rehabilitation and medical treatment is formed, which solves the discontinuity of body process management and state monitoring.

Eighth, the overall "health service and management", centered on the human life cycle, makes up for the deficiency of the overall health service and management caused by shifts in the living scenarios of the elderly.

4. Case study and perspective

To support our proposed novel perspective, a case study was performed to further explain the comprehensive medical care framework. In general, there are diverse outpatient services for the patients, such as cardiac rehabilitation, occupational therapy, physical therapy, pulmonary rehabilitation and speech-language therapy, etc. This is because the reason for injury can be from an accident or injury, surgery, an illness, drug or alcohol abuse or even mental illness. In many cases, people undergoing outpatient therapy have had a severe accident, sickness or other crisis that has turned their lives upside down. It can be overwhelming and exhausting to figure out how to adapt from being in a hospital to living in the world at large. The rehabilitation hospital's Outpatient Department services usually include physical and occupational therapy, speech, language and swallowing therapy, cardiac rehabilitation, concussion management and a memory evaluation and treatment service. Various exercise and education programs are also available through the general hospital center. Due to the complexity of the hospital system, we had to simplify this case study by using only one example. Hence, we introduce medical care examples in the hospital using a rehabilitation robot for patients after stroke. The proposed solution considered multiple medical phases as one whole procedure. The other previous research involved irregular daily medical management without a system administrator of the care system. The incomplete data analysis of the human body may lead to a misdiagnosis and misuse of medical procedures. Furthermore, the insufficient data sharing among different medical phases also confuses the doctor and the patients during the recovery procedure. Different from this research, a novel medical care framework is proposed to overcome the limitations in this paper. The construction of the novel "five-in-one" comprehensive medical care framework integrates intelligent diagnosis, medical management and data sharing, aiming to overcome the above limitations.

As we introduced in the previous sections, patients should pass a full diagnosis first before treatment. The proposed "five-in-one" comprehensive medical care framework for rehabilitation and nursing will be activated, and the typical rehabilitation process is as shown in Figure 6. The system will help plan and evaluate their rehabilitation depending on the patient's situation. Then, it will determine to which part the patients should go and help them relearn how to go about their daily life. In the paper, we focus on upper-limb rehabilitation, which helps patients regain muscle control and function for the upper limb after a stroke.

During this phase, it is essential to determine the stage of the patient. As it is shown in Figure 7, this system requires the entry of patient information at the beginning, and then it checks the status of each joint and chooses a different status, which will be discussed in the following sequence.

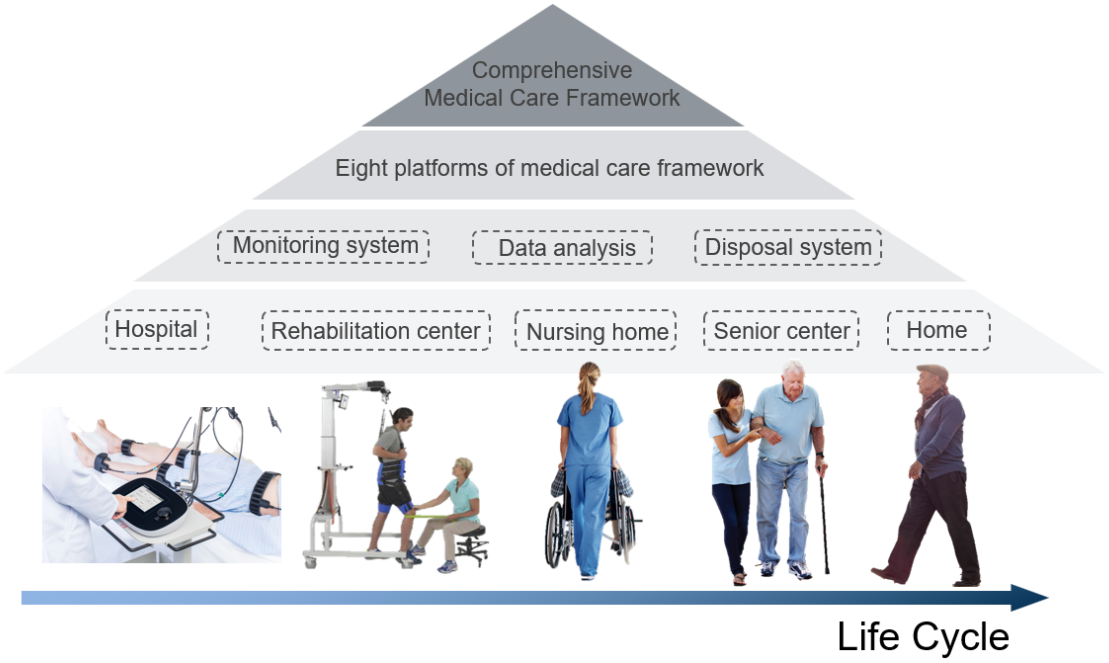


Figure 6. Rehabilitation process.

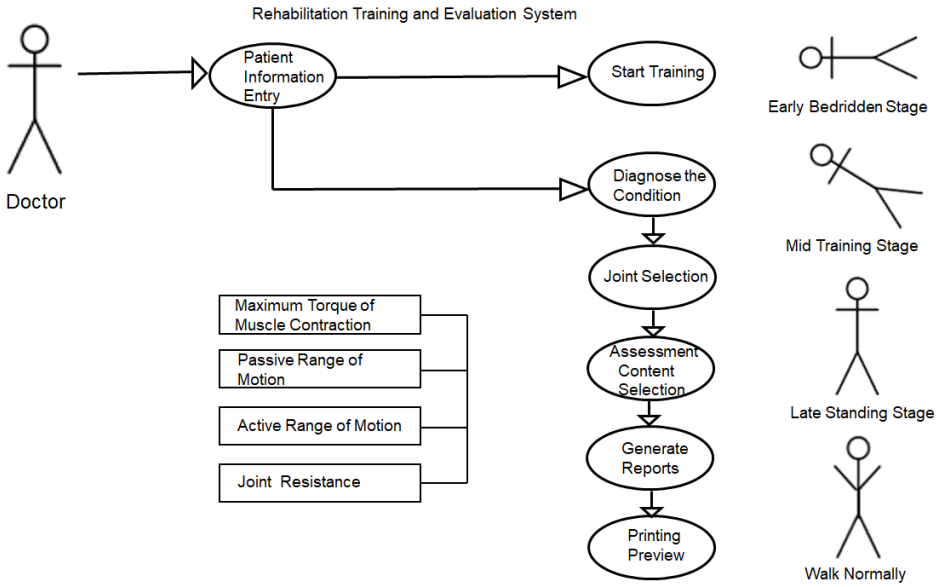


Figure 7. Use of rehabilitation robot in "five-in-one" care framework.

(1) Hospital: If the situation of the patient is bad and he/she cannot move and loses the function of the upper limb, the treatment might be given by physical therapists in the hospital. Due to the expensive service payment, the specialist will conduct professional care and treatment in the hospital. In general, it is necessary to improve the brain, blood and limb examinations, understand these aspects in detail, and select drugs according to the examination results. Drug treatment is the basis and is

indispensable. The second aspect is to cooperate with relevant rehabilitation treatment measures. For example, if stroke patients have symptoms of hemiplegia, they need to cooperate with acupuncture, massage, acupoint injection, hemiplegic limb function training, etc. If the person with stroke has clinical symptoms of speech dysfunction, acupuncture, massage, speech function training, etc. are needed. It needs to be handled in time; otherwise, the treatment effect of this disease will not be good after a long time.

Here, we introduce a study using rehabilitation robots as an example. As it is shown in Figure 8, the platform was presented with a visual interface. An exoskeleton was used to assist the patient in performing body training in a passive mode. It means that the patient has no or very weak ability to conduct the movements. The desired movement was set by the doctor using teaching by demonstration. A set of movement series was learned by the rehabilitation robot, and the robot repeated the different movements. In this situation, the patient had to do this in the hospital with guidance from the expert. Figure 9 shows its control diagram and user flow. Detailed information on the visual interface for the function of the rehabilitation robot can be found in Figure 10.

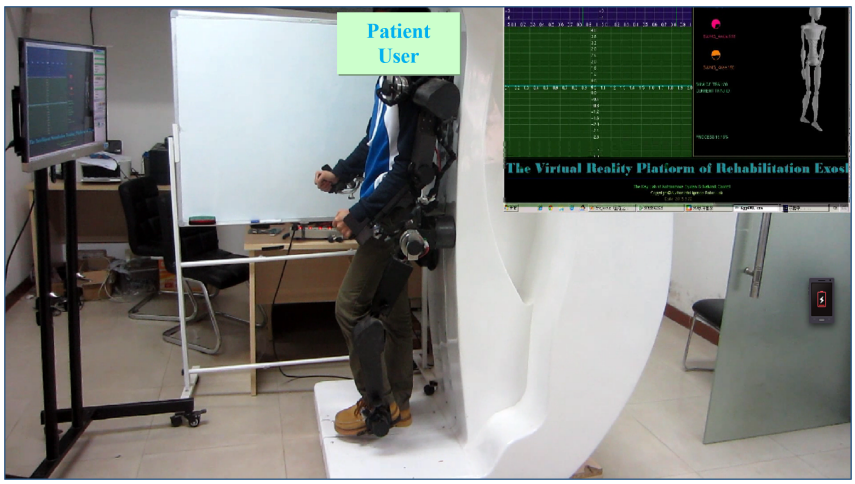


Figure 8. Platform of the rehabilitation robot.

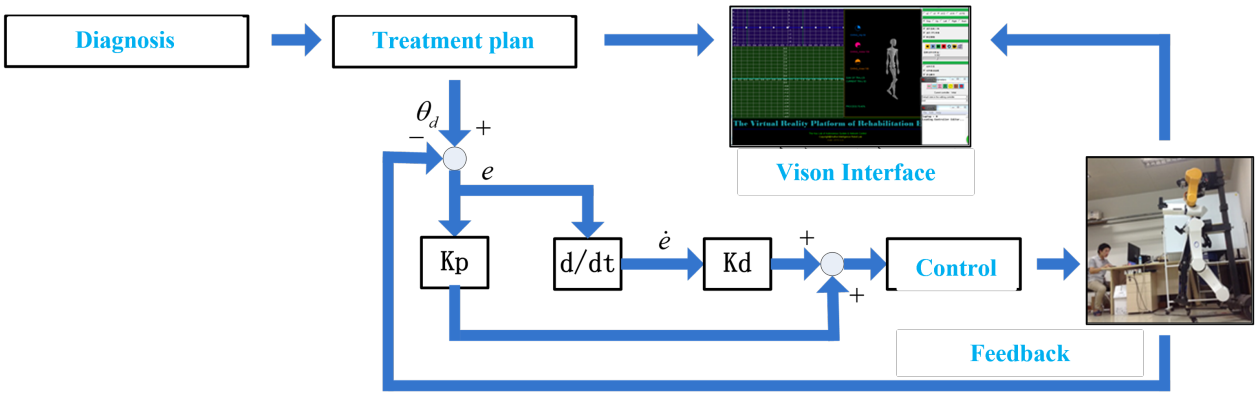


Figure 9. Training diagram of the rehabilitation robot.

A novel platform software has been introduced to perform the rehabilitation and assistance in this

situation. It monitors the patient's health situation, and once the patient can do the training independently, he/she will be moved to the next stage.

As it is shown in Figure 10, a visualization of the body status was viewed by using 3D construction technologies. One subject, 56 years old, was employed to perform a test on the system.

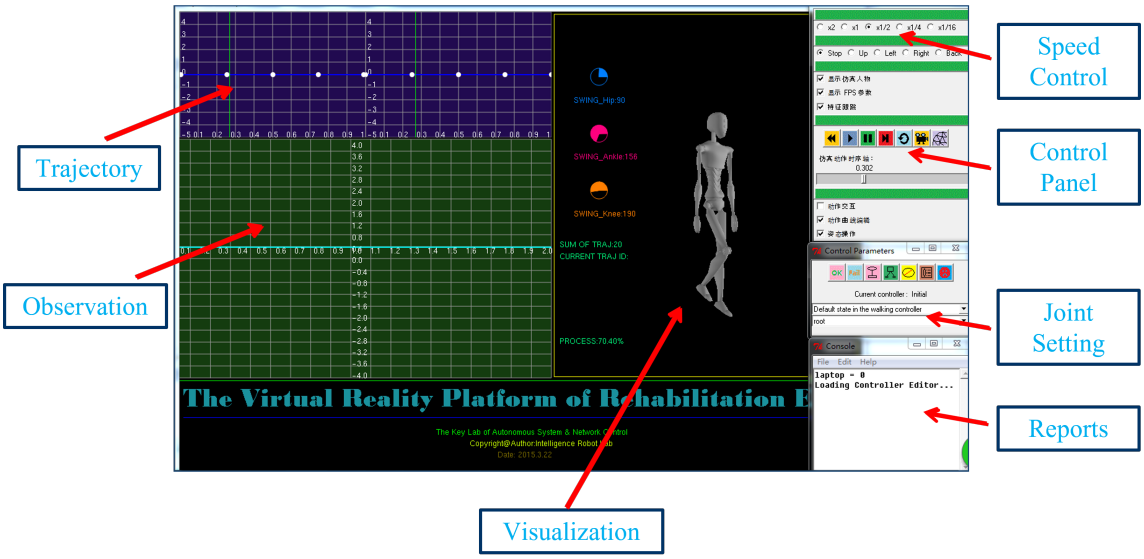


Figure 10. User interface for the rehabilitation robot.

Figure 11 shows the results, in the form of the trajectory of the shoulder joint a human walking movement using this system. The corresponding tracking rehabilitation is shown in Figure 12. Figure 13 presents the performance of tracking in different phases.

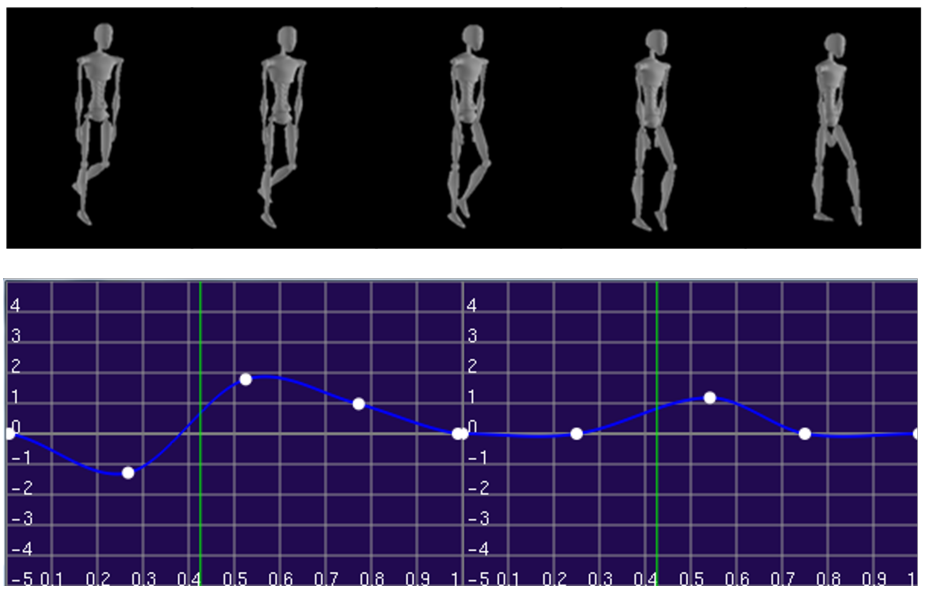
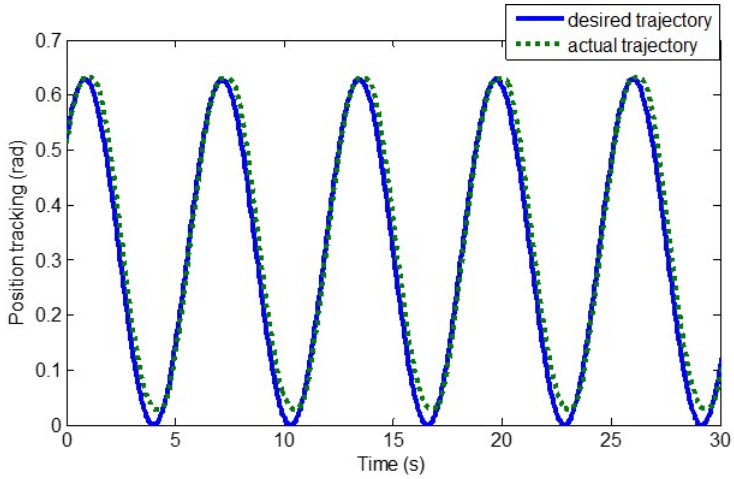
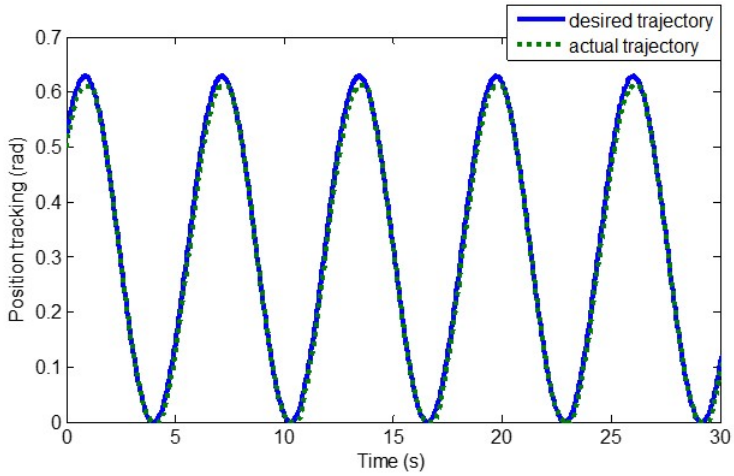


Figure 11. Dynamic procedure during the training of the rehabilitation robot.



(a) The joint tracking during the training of the rehabilitation robot in hospital



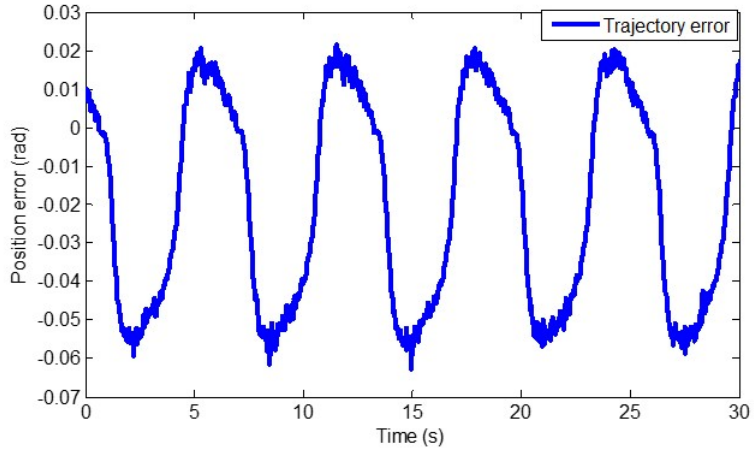
(b) Joint tracking during the training of the rehabilitation robot in the rehabilitation center

Figure 12. Joint tracking in different phases.

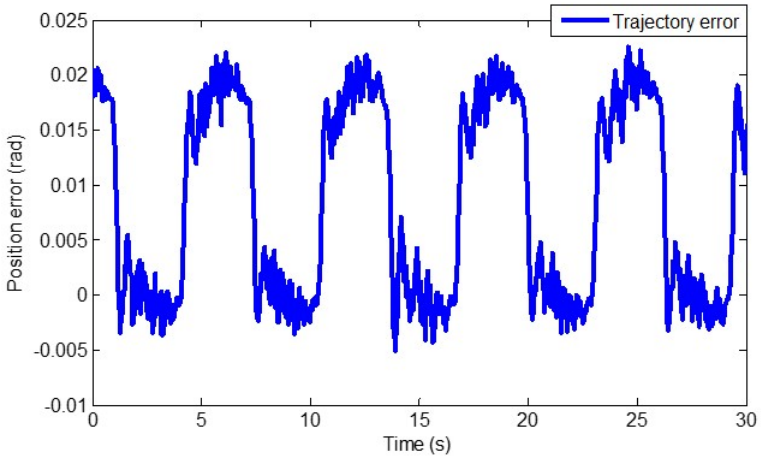
(2) Rehabilitation Center: After the patient receives emergent therapy in the hospital and starts to get better, they will be discharged from the hospital. However, this is far from full recovery and getting back to normal. To boost the progress of rehabilitation, the patient will turn to a rehabilitation center, where more professional rehabilitation methods are available. For patients suffering from hemiplegia, therapists will implement movement therapy by implementing a facilitation technique. Moreover, physiotherapy is conducive to restoring movement and function. Furthermore, traditional rehabilitation therapies such as medical baths, acupuncture and massage significantly facilitate comprehensive recovery. Apart from traditional therapies, rehabilitation also prepares modern devices for the patient, like upper-limb rehabilitation robots.

(3) Nursing Home: Due to the enormous cost of professional rehabilitation, the patients will normally be transmitted to an ordinary nursing home to get ordinary nursing care. Regular physiotherapy is still required in the nursing home to accelerate recovery, and traditional therapies also play a critical role in this stage. Besides, dietary therapy is helpful for the health of the person, and wholesome foods such as fruit, vegetables and peanuts are highly recommended. In the case of

severe dementia, beneficial therapy will be offered to ease the patient's stress and calm them down.



(a) The joint tracking error during the training of the rehabilitation robot in hospital



(b) Joint tracking error during the training of the rehabilitation robot in the rehabilitation center

Figure 13. Performance of tracking in different phases.

(4) Senior Center: When the patient manages to support themselves, they will be allowed to leave the nursing home and resume their recovery in a senior center that is designed to fulfil the needs for physical care and social contact. As the saying goes, you are what you eat. Therefore, it is necessary for people to keep a regular and healthy diet in the senior center, especially for those recovering from a sudden stroke. If the senior center is well funded, the massage service may also be available to promote blood circulation, relieve pain and increase muscle activity. Moreover, the senior center furnishes prevalent equipment and organizes recreational activities to assist the patient in reentering society physically and mentally.

(5) Home: Rehabilitation is a long-term process, which means that the home is another place for lasting recovery. It is believed that the longer the rehabilitation period, the healthier the state that the patient will maintain. Hence, even if the patient is permitted to go home and behaves like a normal person, they had better extend their rehabilitation journey. For example, they can take medicated baths

and keep dietary therapy so as to boost immunity. Furthermore, it is reasonable to monitor daily physical data in the case of the recurrence of the disease.

Above all, in the different phases, the patients need various assistance levels of the rehabilitation robot. Hence, various devices in different positions can be equipped to assist the patient in recovering their health. The case study shows that after the diagnosis, the patients can be separated into different rehabilitation procedures. The training performance is absolutely different in various phases. Although both of them had success in training, the performance shows that the training in a hospital is much more accurate than in a rehabilitation center. When the error in the rehabilitation center can be accepted, the proposed medical care framework will move the patient from the hospital to the rehabilitation center. In this case, the hospital resources can be saved for other people. It provides a more commercial and flexible administration framework.

5. Conclusions and discussion

In summary, based on integrated medical technology, engineering sciences, literature and sciences, the design and construction of the "five-in-one" comprehensive medical care framework meet the requirements for monitoring, analyzing, managing and intervening in the population's health status. It provides a more commercial and flexible administration framework. The advanced management method guarantees the integrity and systematicity of health data, fully demonstrating the advantages of supply chain management for the elderly. Therefore, more systematic and comprehensive control of the elderly lifestyle and health status can be attained to improve the life quality and happiness index of the elderly. Moreover, the "five-in-one" comprehensive medical care framework has also established a new lifestyle model, which unites home care, medical management, nursing care, medical rehabilitation and medical treatment, thereby providing a favorable assurance for daily health monitoring and management. Furthermore, this research is the first to merge supply-side theory and supply chain management methods, medical-engineering integration, literature-science integration, and health service and management ideas and applies them to elderly care. This act of innovation will not only promote the development of the elderly care model and the medical care system model but it will also usher in new opportunities in the field of elderly care.

Although extensive efforts have been devoted to constructing the "five-in-one" comprehensive medical care framework, many medical and elderly care integration issues still need further study and modification. In addition, with the evolution of the elderly care industry, multiple demands are bound to emerge continuously. Therefore, cross-disciplinary ideas can be of significance to better promote the blossoming of elderly care.

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Conflict of interest

The authors declare that there is no conflict of interest.

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