Research on Intelligent Home Care based on "Double Full" Model

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Abstract: In the era of rapid development of "Internet", our country is accelerating into the aging society, and the pension industry is relatively immature. In such an era, how to solve the increasingly serious social aging problem through intelligent means is becoming more and more important. This study aims to establish an intelligent full chain of home care and a "double" model of all levels, so as to provide all-round and high-quality elderly care services for the elderly.

Keywords: Intelligent Home Care for the Elderly; The Whole Chain; Whole Stratum

1. Introduction

Population aging and information technology are two major trends in the development of modern society.[1]

Population aging has become a global challenge, and China, as the country with the largest elderly population in the world, is facing a particularly severe pressure to support the elderly. At present, aging, aging and fewer children have become the trends of China's population development.[2] According to China's population data at the end of 2023 released by the National Bureau of Statistics, the total number of elderly people aged 60 and above in China is 296.97 million, accounting for 21.1% of the country's total population. Among them, the population aged 65 and above is 216.76 million, accounting for 15.4% of the country's total population.[3] From the perspective of demographic structure, China's population aging degree is continuing to deepen. In recent years, the number of births has been decreasing, while the elderly population has continued to increase, resulting in an increasing proportion of the elderly population in the total population, and the aging problem has become increasingly prominent. This makes it difficult for traditional family pension and institutional pension models to meet the growing demand for pension. However, aging itself is not a social problem, health and longevity is everyone's beautiful yearning, but also the ethical direction of the national public policy, the lack of preparation for rapid aging is the real problem. The acceleration of aging and aging has led to the growing demand for elderly care, especially the growing demand for care services, which makes it difficult for traditional family and institutional care models to meet the growing demand for elderly care.[4]Due to the increasingly prominent social problems, smart pension as a modern pension model is born. It uses modern information technologies such as the Internet, big data and artificial intelligence to provide efficient, convenient and personalized services for the elderly.[5]

The British Life Trust first proposed the concept of smart elderly care, also known as the "fully intelligent elderly system",[6] Which breaks the limitations of time and space conditions in the inherent traditional pension model, and provides higher quality pension services for the elderly.Based on smart pension, scholars have carried out research from multiple dimensions and proposed a variety of smart pension models. At present, there are four common smart pension models in the society: community pension, home pension, institutional pension and virtual pension.[7] According to different pension participants, such as the government, families, third-party enterprises, information platforms, medical institutions, health insurance companies and intelligent terminal manufacturers, Wang Qingde classifies and combines them, and puts forward four different smart pension models.[8] Zhang Lei et al. focused on the dimensions of applicable sites, smart device applications and

service uses, and conducted in-depth research on the smart pension model.[9] CAI Xiaoshen et al. rely on the actor model, in-depth analysis of the collective cooperation model in smart elderly care.[10]Wu Yuxia et al. subdivided the smart pension model into four parts, including DMP mode, DtoP mode, PtoD mode and OtoO mode.[11] Liang Changyong et al. focus on the future development of smart pension and put forward a new model of high-quality development - global pension.[12]

The family is the starting point of the journey of life, but also the ultimate destination of the patient's disease treatment. Smart elderly care in the home scene plays an important role in today's health service system. Home health generally refers to the use of intelligent technology and service means to introduce health management and medical support into the home environment to provide convenient and personalized health services for residents. It covers daily health monitoring, chronic disease management, rehabilitation training, psychological support and other contents, aiming to help users achieve health self-management and long-term curative effect maintenance. A large number of studies have shown that family-based chronic disease treatment, postoperative rehabilitation nursing and health promotion have higher economic benefits and rehabilitation effects under effective guidance.[13]

The promotion of smart elderly care not only needs to run through the whole process of elderly care services, but also should cover different classes of elderly groups. The whole chain of smart pension focuses on the full service from prevention, care to rehabilitation, while the whole class of smart pension focuses on meeting the elderly with different income levels, health conditions and living needs. From the perspective of the whole chain and the whole class, this paper systematically sorts out the development status of smart elderly care, analyzes the challenges it faces, and looks forward to the future development direction, aiming to provide theoretical support and policy reference for the high-quality development of smart elderly care.

2. Development Status of Smart Home Care Model

2.1 Policy Support

With the gradually serious problem of aging society, the Chinese government has also begun to attach great importance to the development of smart elderly care and issued a series of policies to support it. In 2017, The State Council issued the Opinions on the Formulation and Implementation of Elderly Care Service Projects, which for the first time proposed to focus on the development of "smart and healthy elderly care services".[14]In the same year, the state officially announced the "Smart health elderly care Industry Development Action Plan" emphasizing the application of intelligent health management model, hoping to build a comprehensive multi-functional home care service system with the help of the cutting-edge network information platform. This system can skillfully connect and efficiently integrate multiple resources such as residents, communities, medical institutions, government departments and elderly care institutions. Therefore, we will provide more real, accurate and intelligent elderly care services for the elderly, thus significantly improving the quality of life and happiness of the elderly.[15]

In 2019, the National Health Commission and other departments jointly issued the Opinions on Promoting the Development of Elderly Care Services, further clarifying specific measures for the development of smart elderly care. The implementation of these policies will provide strong political support and institutional guarantee for the development of smart pensions. In 2021,the 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Outline of Vision Goals for 2035 clearly put forward: "We will promote the coordinated development of the elderly care service and the elderly care industry, improve the basic elderly care service system, vigorously develop inclusive elderly care services, support families in assuming the role of elderly care, and build a system of elderly care services in which home-based community institutions are coordinated and medical care and nursing care are integrated."[16] The State Council issued the "14th Five-Year Plan" for the Development of the National Cause for Aging and the Elderly Service System, which requires improving the level of smart home care services, creating an age-friendly social atmosphere, improving the development service support system, and promoting smart action to meet the needs of the elderly.[17]In order to integrate

elderly care service resources and realize the supply and demand matching of home care services, the smart home care service platform came into being under the active promotion of the state.[18]

The National Development and Reform Commission has pointed out that China will enter the stage of moderate aging during the 14th Five-Year Plan period, and it is necessary to attach great importance to developing elderly care services and improving the health support system for the elderly.[19]The formulation and implementation of these policies have injected a strong policy impetus for the development of smart elderly care, and provided a perfect system guarantee.

2.2 Technology Application

With the transformation of the aging structure of society, middle-aged and elderly people can gradually feel the weakening of family pension function and the lack of social pension resources, and social science and technology can help develop a new pension model.[20]Science and technology can provide powerful tools and intelligent methods for smart elderly care, and the support of modern information technology is the key to the development of smart elderly care.[21] In the field of smart elderly care, the application of Internet, Internet of Things, big data, artificial intelligence and other technologies has been very extensive. For example, smart wearable devices can monitor the physiological indicators of the elderly in real time, telemedicine systems can provide convenient diagnosis and treatment services for the elderly, and smart home systems can provide intelligent control of the home environment for the elderly to facilitate their daily life.[22]Through the application of these technologies, the efficiency and quality of elderly care services have been greatly improved.

2.3 Service Mode

Since 2007, China's smart pension has roughly experienced these five stages: digital pension, information pension, science and technology pension, networked pension, smart pension. The service model of smart elderly care continues to innovate and improve. At present, the following models have been formed:

Smart community elderly care model: Based on the existing resources of the community, it integrates medical, rehabilitation, nursing and other services through information means to create a full range of elderly care services for the elderly in the community.[23]

Smart home care: With the help of smart devices and remote monitoring systems, it provides a number of services for elderly people at home, including safety monitoring, emergency rescue and life care.[24]

Intelligent institutional elderly care: The use of information technology to improve the management level and service quality of institutional elderly care, such as intelligent management system, remote care system, etc.[2]

The combination of smart medical care: the use of information means to integrate medical and elderly care resources, achieve efficient docking of the two, and create a continuous and integrated medical care service model for the elderly.

Among them, the most significant effect is the smart home elderly care service.[25]This model can take the data center as the platform, use cloud computing, big data and other technologies to efficiently respond to the diverse needs of the elderly, in order to provide convenient and scientific services, and can best meet the market demand of modern elderly care services.[26]

Various regions in our country are actively promoting the construction of smart home care service projects. For example, Shanghai Hongqiao Community Bridge, for emergency services that the elderly need most, set up emergency "one-click" telephone sets and combined with the Internet, and achieve 24-hour meal delivery, housekeeping cleaning and other services. Hangzhou Xihu District promotes the construction of smart home elderly care service system by installing "smart three-piece sets" (namely smart inductance, smart gas sense, and smart smoke sense); Qingdao Laixi City has explored the establishment of a smart home elderly care service supervision platform, established elderly care health records and tracked the physical conditions of the elderly, forming a model of online booking and offline easy check-in.[27]

Many different approaches and technologies are being explored around the world to improve, support and help the lives of older people. Japan's assistive, social robots; Smart homes in Australia; "Aged in place" in America; The UK's service system framework follows the trend and

provides more humanized information services for older people around the world.[28]

All in all, driven by the wave of innovation in today's society, the precise implementation and in-depth promotion of smart home elderly care services is becoming a key measure to meet the needs of personalized and diversified elderly care services for the elderly. The realization of this goal is inseparable from the strong support of advanced information technology, as well as the high attention and active promotion of local government agencies and relevant departments. We firmly believe that through the continuous efforts and collaborative cooperation of all parties, the smart home care service system will achieve a higher level of precision and comprehensive in the future, provide better services and all-round protection for the elderly, and effectively improve the happiness index of the elderly in China.[29]

3. Research on Smart Home Care Model from the Perspective of Whole Chain and Whole Class

3.1 Full Chain Pension Model

3.1.1 Smart home care full chain

The smart elderly care system should not be reduced to digital monitoring terminals and one-click "call transfer", but a set of intelligent systems that run through the whole business chain. As early as 2017, some scholars proposed this new pension model. When the "Internet of Things technology + Internet thinking" is combined with the elderly care service model, a "magic" reaction occurs, and the smart home care chain model becomes the guide for offline services, which is bound to bring a diversified, humanized and efficient model innovation for home care.[30]

The whole chain of smart home care refers to an aging industry ecological chain system supported by technology, with smart devices as tools, with service platforms as Bridges, and with diversified services as content. It is committed to fully meeting the diverse needs of the elderly, improving their quality of life, and contributing to the sustainable development of the aging industry. This model is a dynamic and constantly evolving system. With the acceleration of scientific and technological progress and the changing needs of the elderly, the whole chain of smart home care must continue to be adjusted and optimized to better adapt to the emerging market needs and technological changes.[31]This model not only improves the quality of life of the elderly, but also provides new ideas and directions for the high-quality development of the elderly care industry.

3.1.2 Improve the whole chain service system

We believe that the embodiment of the full chain service system is to build a "medical, health and nursing integration" service chain by integrating medical, rehabilitation, nursing and other resources to provide the elderly with full health management and old-age care services from prevention to rehabilitation.[16]At the same time, with the help of intelligent auxiliary devices and remote care systems, wearable devices and remote monitoring technology, it can not only improve the efficiency and quality of care services, but also monitor and warn the health status of the elderly in real time. [13]In addition, virtual reality (VR) and tele-rehabilitation technology are used to provide personalized rehabilitation training services for the elderly.[2]

3.2 Full Class Pension Model

3.2.1 The whole class smart home care

The whole class smart home care is a comprehensive elderly care concept, which integrates modern technology and elderly care services, and is committed to providing convenient, safe and high-quality practical home care services for the elderly at different consumption levels.At present, in terms of the development status of foreign countries, developed countries are ahead of China, and have flexibly carried out smart elderly care related practices for different needs and consumption levels and different service scenarios, and have obtained certain results. For example, Japan prefers to use high-quality high-tech equipment to better meet the needs of the elderly, and private nursing homes in Canada use remote technology to monitor the elderly for 24h. Since 2010, China has successively carried out the practice of smart home care for the elderly, but the number of people covering the population level is less than that of foreign countries and is not comprehensive.[32] Through the integration of intelligent technology and equipment, combined with modern information technology such as the Internet of Things, cloud computing, and big data, the model creates a comprehensive and multi-level home care service for the elderly. This model

breaks through the limitations of traditional elderly care, so that the elderly can enjoy efficient, personalized and intelligent elderly care services at home.

3.2.2 Promote the coverage of services at all levels

Multi-level and differentiated smart elderly care products and services should be developed to meet the needs of elderly people at different income levels.[33]It is also necessary to pay attention to special elderly groups, develop special intelligent care services for disabled and semi-disabled elderly people, and provide intelligent companionship and safety monitoring services for elderly people living alone.[14]And increase the investment in smart elderly care in rural and less developed areas, narrow the gap between urban and rural elderly care services, promote the coordinated development of urban and rural elderly care services, and achieve common progress.[34]Based on the senior-centered care concept, [35]respecting the elderly, providing emotional care and creating a supportive environment should be the feasible direction for the continuous improvement of the smart elderly care model.

3.3 "Whole Chain" Smart Home Care Service Model

This time, we aim to use modern information technologies such as the Internet, the Internet of things and cloud computing to build an innovative "online + offline" combined home care service model. In terms of online platforms, we have introduced an elderly care service information platform, and deployed a series of intelligent products in the elderly's home, including "intelligent health detection equipment", "health monitoring wearable equipment", "intelligent home care system", "remote health care system" and "SOS call fall and alarm positioning system". Through the cloud server, mobile phone APP and wechat and other media, the remote real-time monitoring and management of the health data and geographical location information of the elderly at home is realized, ensuring the instant upload and sharing of information.

The offline platform, as a home care service center, undertakes multi-dimensional comprehensive assessment of the elderly's self-care ability, psychological and emotional state, daily life pattern and social interaction. Based on these evaluation results, the elderly or their children can customize personalized elderly care service plans according to their actual conditions, so as to accurately meet the diversified needs of elderly care services.

The "whole chain" smart home care service model also focuses on the deep integration of online and offline service platforms. By integrating the elderly care service information platform and telemedicine service platform, we take personal electronic health records as the core, and introduce advanced means such as automatic monitoring system, health management APP and smart home devices to carry out continuous and dynamic supervision and record of the health status of the elderly. This model not only improves the efficiency and quality of elderly care services, but also provides strong data support for subsequent health management and service optimization.

3.4 "All-Class" Smart Home-Based Elderly Care Services

3.4.1 Basic Smart Elderly Care Services

In response to the health management needs of economically constrained elderly groups amidst China's aging society, an innovative "dual-system integration" smart healthcare service system has been established. This system achieves a full-process closed-loop management of "prevention-monitoring-intervention" through the organic synergy between the IoT health monitoring system and the smart home system.

For elderly individuals with relatively limited economic conditions, basic smart elderly care services can provide necessary life support and health monitoring at a lower cost. By equipping them with basic devices such as smart bracelets and smart blood pressure monitors, key physiological data such as heart rate and blood pressure can be monitored in real-time and synchronized to the cloud, allowing family members or healthcare personnel to view the data at any time. Additionally, the smart home care system (such as smart lighting and smart curtains) can automatically adjust indoor lighting and temperature, providing convenient living assistance services for the elderly. In emergency situations, the IoT health monitoring system or home care system will automatically trigger an alarm mechanism to promptly notify family members or the community service center, ensuring the safety of the elderly.

3.4.2 Comfort Smart Elderly Care Services

For elderly individuals with moderate economic

conditions and a pursuit of quality life, comfort smart elderly care services have expanded functions and personalized upgrades based on basic services. The smart home system can be customized according to the elderly's lifestyle habits and preferences, such as smart voice assistants and smart kitchens, simplifying daily operations and further enhancing life convenience and comfort.

In terms of health management, comprehensive health data analysis, disease prevention suggestions, and rehabilitation guidance are provided in conjunction with advanced algorithms. This not only helps the elderly to understand their health status in a timely manner but also effectively promotes early disease prevention and scientific management, thereby enhancing their physical function and self-care abilities, allowing the elderly to better manage their own health.

Considering the social isolation and psychological loneliness that elderly individuals may face, the "All-Class" smart home-based elderly care service model innovatively incorporates interactive methods such as social platforms and online games,pension products through with wisdom and interactive enriched the elderly pension life that occupy the home, meet the demand of the realization of self-worth, broke the traditional depressing pension mode.[36]This not only enriches the spiritual and cultural life of the elderly but also builds a social bridge that transcends geographical limitations for them, effectively alleviating feelings of loneliness and anxiety, and significantly improving their life satisfaction and happiness.

3.4.3 High-End Smart Elderly Care Services

Targeted at elderly individuals with better economic conditions and a pursuit of high-quality life, high-end smart elderly care services offer more personalized and professional service content. Private health consultants provide one-on-one health management services to the elderly, which not only cover daily health consultations and the formulation of disease prevention strategies but also delve into scientific guidance on nutritional diets, ensuring that each elderly person receives the most suitable health management plan.Life care services are also highly customized. Based on the specific needs and preferences of the elderly, the service team will provide them with professional personnel such as private chefs and home service providers to meet their high-quality lifestyle needs. In the areas of rehabilitation and health safety protection, high-end smart elderly care services also demonstrate forward-thinking technological advantages. The provision of advanced smart rehabilitation equipment (such as smart wheelchairs and smart walkers) and the introduction of smart security systems (such as smart door locks and smart surveillance) help the elderly recover or maintain their physical functions, enhance their self-care abilities, and comprehensively ensure their living safety. This service model not only highlights the enormous potential of technology in improving the quality of life for the elderly but also sets a new benchmark for promoting the development of the smart elderly care industry.

Through differentiated elderly care services, the needs of elderly people with different consumption concepts can be more accurately met, the effective implementation and sustainable development of services can be achieved, and the "whole class" smart elderly care service model can be built, so as to improve the inclusive and efficient smart elderly care service system.[37]

4. Development Strategies for the "Dual-Comprehensive" Smart Home-Based Elderly Care Model

At present, the development of home care is mainly focused on smart home and home service, health and smart medical treatment, artificial intelligence and technology application, and health and lifestyle. Through the research of age-appropriate home, family doctor, traditional Chinese medicine health, optical fiber intelligent monitoring, health production function and other directions, it provides effective and specific strategies for the life experience, disease prevention and treatment, mental health, etc., and also promotes the combination of medical and nursing care at home for the elderly. Home-based care is more inclined to allow the elderly to form an active and healthy lifestyle. And the "double full" intelligent home care model we discussed should be further developed for this purpose.

4.1 Promoting Technological Innovation and Application

To drive the in-depth development of the "dual-comprehensive" smart home-based elderly

care model (i.e., the "full-chain" smart home-based elderly care service model and the "all-strata" smart home-based elderly care service types), our primary task is to strengthen the research and development of key technologies and their innovative applications.[13]Specifically, we should focus on cutting-edge technologies such as artificial intelligence, big data, and the Internet of Things, exploring new applications and models in the field of elderly care. At the same time, it is necessary to actively promote standardization construction, formulate complete technical standards and service norms for smart elderly care, and clarify key standards such as communication protocols and data formats for smart elderly care devices, systems, and platforms, to ensure effective integration between products from different manufacturers and interoperability between different systems and platforms.[19]The smart pension model supported by smart technology can effectively promote the effective integration of pension resources, model reform and system optimization, and provide real-time, efficient, intelligent, convenient and interconnected smart pension services for the elderly from the perspective of micro-needs. At the same time, the Opinions of The General Office of the State Council on Promoting the Development of Elderly Care Services promulgated in 2019 clearly put forward that "continue to promote the development of the smart and healthy elderly care industry and expand the application of information technology in the field of elderly care".[38]

Liang Yanying, a deputy to the Municipal People's Congress and chairman of the New Modern Social Service Group, who has been deeply engaged in the field of elderly care for 17 years, said, "I look forward to embracing AI technology tools to improve the quality of elderly care services." Artificial intelligence is better at data processing, early warning and other work, manpower is better at emotional communication, personalized service and emergency work, through a reasonable division of labor, give full play to their respective advantages, can improve the efficiency and quality of elderly care services. At the same time, virtual reality technology can be used to provide virtual social scenes for the elderly, and intelligent robots can also be introduced to accompany and care for other work.[39]

The development direction of smart elderly care services can be based on the core needs of the elderly such as daily life care, health monitoring, emergency assistance, and the development of smart wearable devices, smart mattresses, and smart medicine boxes. For disability, dementia and other special groups, focus on the development of intelligent rehabilitation AIDS and care robots; Promote the application of intelligent security systems in elderly care institutions and home scenes to achieve real-time monitoring and early warning of the behavioral trajectory and vital signs of the elderly.[40]

While promoting technological innovation and application, information security protection cannot be ignored. We should establish and improve a smart elderly care information security protection mechanism, adopt advanced encryption technologies, anonymization processing, and other means to effectively safeguard the personal privacy and data security of the elderly.[41] In addition, it is necessary to establish a complete data backup, recovery, and disaster recovery mechanism to ensure the absolute security of data during transmission, storage, and processing.

To accelerate the popularization and application of the "dual-comprehensive" smart home-based elderly care model, we need to focus on improving older adults' acceptance and proficiency in using new technologies. We believe that this can be achieved by conducting training courses on the use of smart devices for older adults, covering a variety of smart products such as smartphones, tablets, and smart wearable devices, to help them quickly grasp the basic operations and application skills of new technologies. At the same time, establishing smart elderly care experience centers or service stations within communities to provide on-site guidance and consultation services for older adults will further stimulate their interest and enthusiasm for new technologies, promoting the widespread application and in-depth development of the "dual-comprehensive" smart home-based elderly care model.[42]

4.2 Strengthening Policy Support and Financial Investment

Government policy support and financial investment can effectively drive the in-depth development of the "dual-support" smart home-based elderly care model. Specifically, the

government should first improve the relevant laws and regulations system, conduct a comprehensive review and in-depth assessment of the existing laws and regulations related to smart elderly care, and accurately identify legal gaps and potential issues. Based on this, it should then propose targeted suggestions for improving laws and regulations and a plan for constructing a standard system, providing solid legal guarantees for the healthy and orderly development of the smart elderly care industry.[10]The government can also formulate a series of incentive policies. For example, since the state can build and support limited elderly care institutions, it can strongly encourage and guide market and social forces to actively participate in the construction of elderly care institutions, and introduce private capital and social forces to establish more private elderly care institutions.[43]The government also needs to formulate supportive policies for social forces to participate in elderly care services in many aspects to reduce its construction and operation costs.[44]

Secondly, the government should increase financial investment to ensure the continuous optimization and improvement of smart elderly care infrastructure and service systems. This includes, but is not limited to, the procurement and deployment of smart elderly care equipment, the construction and upgrading of service platforms, and the training and introduction of professionals. In addition, the government can attract social capital to actively participate in the smart elderly care industry through a series of preferential policies, such as implementing tax reductions or preferential measures for enterprises involved in the smart elderly care industry, and providing certain subsidies or rewards to enterprises or institutions that provide high-quality smart elderly care services. These measures not only help alleviate the government's financial pressure but also effectively stimulate market vitality and promote the prosperity and development of the smart elderly care industry.[45]

At the same time, government departments can consider including smart elderly care services into the coverage of long-term care insurance, implement hierarchical reimbursement policies according to the social security status, self-care ability and smart elderly care needs of the elderly, and improve the smart elderly care reimbursement system, so as to reduce the economic burden of the elderly and ensure the smooth implementation of smart elderly care services.[32]

The government also needs to strengthen the combination of "medical" and "nursing", advocate multi-departmental cooperation, integrate "medical" and "nursing", achieve "medical care" and "nursing care", and promote the deep integration and development of this pension model with other related elderly care services, so as to meet the needs of society for elderly care services.[46]

4.3 Strengthening the Cultivation of Professional Talents

The report to the 20th National Congress of the Communist Party of China clearly put forward the implementation of the national strategy to actively respond to the aging population and promote the coordinated development of elderly care and the elderly care industry. On the one hand, colleges and vocational colleges should actively set up smart elderly care related majors to transport high-quality composite elderly care talents for the industry. At the same time, school students are encouraged to participate in home-based smart elderly care practice projects, open up the channel of teaching and employment, and attract more outstanding talents to join the field of smart elderly care. On the other hand, it is necessary to increase vocational education and publicity, break the social stereotype of the frontline staff of smart elderly care service, enhance the social identity of the profession, and create a good employment environment and atmosphere. [47]

The elderly's demand for all-round, intelligent and personalized wisdom health care continues to grow, and the demand for wisdom health care service talents is increasing.Intelligent home care needs interdisciplinary talents with Internet skills, smart device application skills, elderly care, emergency rescue, domestic service, psychological counseling knowledge. At present, due to the late start of smart home care in China, the social status of elderly care service personnel is not high and the general salary is not high, such talents are relatively scarce in China, and it is difficult to meet the needs of home care service. Therefore, we believe that we can strengthen the training of professional talents from the following aspects.[48]

4.3.1 Deepening Discipline Innovation in Specialized Fields

To ensure the sustained and healthy development of the "comprehensive and intelligent" smart home-based elderly care model, it is particularly important to strengthen the cultivation of professional talents and discipline innovation. The government should actively play a guiding role, encouraging and supporting ordinary universities and vocational colleges to establish majors related to the silver economy based on their own advantages and social demands, in order to broaden students' professional horizons and enhance their awareness and interest in the field of smart elderly care.

In terms of curriculum design, colleges and vocational schools can offer geriatric rehabilitation, geriatric nursing, health management and other related courses to train professionals to meet the needs of health and elderly care.[49]Emphasis should be placed on improving students' knowledge of intelligence, information literacy, and digital technology skills. General education courses on information technology should be offered, covering cutting-edge technologies such as artificial intelligence, big data, and the Internet of Things, so that students can master the necessary technical foundations. Additionally, specialized courses on smart elderly care product development should be introduced, combining theory with practice to cultivate students' innovation and practical abilities, laying a solid foundation for their future careers in the smart elderly care field.

The government should also promote the expansion and digital upgrade of traditional elderly care and management disciplines, enhancing the quality of discipline development through technology empowerment. This includes introducing advanced teaching concepts and methods, strengthening cooperation with enterprises and research institutions, jointly developing teaching resources and cases that meet market demands, and promoting deep integration of industry, academia, and research to provide the smart elderly care industry with more high-quality and versatile talents.

4.3.2 Strengthening Industry-Education Integration Innovation

The state attaches great importance to the deep integration of vocational education and industrial development, and has issued a series of relevant policy documents, such as the Implementation Plan for the Action of Enhancing the integration of Industry and Education in Vocational Education (2023-2025), which clearly points out that it is necessary to promote the general integration of vocational education, the integration of industry and education, and the integration of science and education, and optimize the type positioning of vocational education. In this context, the number and quality of intelligent health care service personnel need to be improved, which also points out the direction for the training of intelligent health care talents, and emphasizes the important position of the integration of production and education in vocational education.[50]In the process of promoting the "comprehensive and intelligent" smart home-based elderly care model, deepening industry-education integration and strengthening innovation in professional talent cultivation is an indispensable part. Government departments at all levels, including those responsible for human resources, civil affairs, and education, should collaborate and guide efforts to actively carry out strategic cooperation on "jointly cultivating regional elderly care talents," aiming to promote the excellent traditional culture of respecting and caring for the elderly and modern scientific elderly care culture, and to cultivate more high-quality professional talents for the smart elderly care field.

Smart home care not only requires the service team personnel to have strong service skills, but also needs to have a certain degree of understanding of smart home care equipment, and do a good job in the publicity of smart home care. Therefore, when training corresponding professionals, schools must carry out systematic and complete training for smart home care, timely training on the role of smart care products and smart care service policy information, and real-time grasp of the latest smart care data in the market.[51]

To this end, schools and government departments can focus on the construction of elderly care culture and education base and digital museum, through physical display, virtual experience and other ways, popularize the knowledge of elderly care, inheritance of elderly care culture. In collaboration with vocational colleges and relevant enterprises, smart elderly care training and practice centers, smart elderly care and silver economy research centers, and smart elderly care teaching and training centers should be jointly constructed, forming a

comprehensive platform integrating teaching, research, and practice to provide students with all-round learning and practice opportunities.

In the process of talent training, we can also actively explore the pilot of modern apprenticeship, and promote the improvement of vocational skill level training and evaluation system such as old-age care. Through university-enterprise cooperation, industry-education integration training bases and elderly wellness and care centers should be jointly established, exploring a joint school-running model under the framework of the "dual system" of talent cultivation to achieve deep integration of theory and practice.

At the same time, actively organize and participate in school-level, provincial, and national smart health care skills competitions or cross-professional collaborative innovation projects, and through the experience of competitions and projects, students can also improve their professional skills and comprehensive literacy. Through the experience of competitions and projects, students' professional skills and comprehensive qualities can be enhanced. At the same time, focusing on volunteer service projects, multiple forces including schools, communities, social organizations, and hospitals should be brought together to jointly create a new elderly care service system integrating medical services, catering services, cultural and entertainment services, care services, basic services, and social work services, allowing students to grow through practice and improve their practical operation abilities and technical skills.

4.3.3 Introducing Virtual Simulation Training Platforms

In the cultivation of professional talents for smart elderly care, cutting-edge technologies such as virtual reality (VR) and augmented reality (AR) can be fully utilized to construct highly simulated virtual scenarios for elderly care. These scenarios cover various aspects such as daily life care, health management, and emergency response to unexpected situations for the elderly, providing immersive learning experiences for trainees. Through the interactive functions of the virtual platform, trainees can participate in various elderly care tasks as if they were in real situations, repeatedly practicing key skills such as assisting the elderly with eating, medication management, and first aid procedures until they are fully proficient.

The platform also contains a large number of real-life cases, which are simulated and reproduced to allow trainees to face various complex situations in a virtual environment, thereby effectively improving their ability to solve practical problems, especially their emergency response capabilities. The trainees' operations in the simulated scenarios are automatically recorded by the system, and the platform generates real-time feedback based on their performance, while providing detailed personalized assessment reports. These reports not only help trainees clearly recognize their strengths and weaknesses but also provide them with targeted improvement suggestions and learning plans, thereby assisting trainees in continuously improving their professional skills and comprehensive qualities and laying a solid foundation for their future career development.

5. Summary and Outlook

Although in the medical scene, there are no emergent keywords that are still hot and clearly indicate specific research objects, in today's Chinese society with an increasingly serious aging population, the elderly have stronger medical needs than other groups. Against the backdrop of China's increasingly prominent aging issue, the smart home-based care model is emerging as a forward-looking and innovative strategy, heralding the mainstream trend of future elderly care services. Amidst the "Internet Plus" era, this model cleverly integrates modern information technology with traditional elderly care services, aiming to leverage the power of technology to provide older adults with more refined and efficient service experiences. Specifically, smart home-based care is committed to constructing a "dual-comprehensive" model that encompasses the intelligentization of home environments and the comprehensive upgrading of elderly care services—namely, achieving full-chain intelligent coverage and all-strata penetration of elderly care services.

The "dual-comprehensive" approach encompassing "full-chain" and "all-strata" smart home-based care—is gradually establishing itself as a significant development direction in the field of smart elderly care. Adhering to the principle of people-centeredness, we pay close attention to the actual needs of older adults, prioritize improving service quality, and uphold the service philosophy of "providing what older

adults need." We ensure that all elderly care efforts are grounded in and ultimately serve the fundamental need of older adults to enjoy a happy later life.

Within the framework of full-chain smart elderly care, we emphasize the comprehensiveness and continuity of services, covering the entire process from preventive healthcare, daily care, to rehabilitation support, ensuring that older adults receive appropriate and continuous care at all stages of life. All-strata smart elderly care, on the other hand, focuses on meeting the diverse needs of older adults with different income levels, health conditions, and lifestyle preferences, striving for broad inclusivity and deep personalization of elderly care services.

Under this model, older adults can flexibly customize exclusive elderly care plans based on their actual situations. The online platform integrates an elderly care information platform, a smart health monitoring system, and remote medical services, enabling real-time tracking and scientific management of older adults' health data. The offline platform, relying on home-based care service centers, provides older adults with diversified and comprehensive services, including life care and emotional support. This innovative "online + offline" integrated home-based care model not only significantly enhances the convenience and efficiency of elderly care services but also profoundly improves the quality of life and happiness of older adults, laying a solid foundation for building a more harmonious and smart elderly care environment.

Looking ahead, the field of smart elderly care will embrace broader development prospects. Through a series of strategic initiatives, including continuously improving the full-chain service system, deepening all-strata service coverage, strengthening policy support and financial investment, and accelerating technological innovation and application promotion, we will be able to significantly enhance the quality and coverage of smart elderly care services, better meeting the diversified and personalized needs of various elderly groups.

The vigorous development of smart elderly care is inseparable from the close cooperation and collaborative efforts of various subjects such as the government, enterprises, social organizations and the elderly. At the government level, the government should continue to increase policy guidance and financial support, establish and improve the relevant laws, regulations and standard system, insist on using digital technology to promote the system reshaping, process reengineering and mechanism innovation of smart elderly care services, and incorporate smart home elderly care into the planning of urban renewal and rural revitalization, as well as into the construction of complete communities. Promote the balanced development of smart elderly care services between urban and rural areas; Promote the popularization and application of household and personal digital products, promote the integrated construction of smart cities, smart communities, digital families and smart elderly care, and provide a solid institutional guarantee for the healthy development of smart elderly care. Enterprises need to focus on technological innovation and application deepening, constantly promote the iterative upgrading of smart elderly care products and the innovation of service models, and actively learn from the advanced concept of aging design of foreign smart products to meet the growing diversified needs of the market. Social organizations should take the initiative to integrate into the smart elderly care service system, and provide more humanistic care and practical support for the elderly through voluntary service and community care.[52]

Older adults themselves should also actively embrace new technologies and models, continuously improving their technological adaptability and usage skills, so as to better enjoy the convenience and benefits brought by smart elderly care. Through the collaborative efforts and continuous innovation of multiple stakeholders, we look forward to building a comprehensive, efficiently coordinated, and sustainable smart elderly care ecosystem, providing older adults with more attentive and high-quality services, and ultimately realizing the vision of a society where "the elderly are well-cared for and enjoy their later years."

References

[1] Wang Xinxin. Research on the path to bridge the digital divide of the elderly under the smart home care model [J]. Public Relations World,2025,(01):163-165.

[2] Wang Lijian, ZHU Yixin, Ma Wei. The actual needs and development path of smart health care industry [J]. Journal of Xi 'an

Jiaotong University (Social Sciences Edition),2024,44(03):31-39. (in Chinese)
[3] Ping-ping wang. Population declined population quality development success [N]. China information news, 2024-01-19 (002) DOI: 10.38309 / n.c. Nki NZGXX. 2024.000148.
[4] Shi J. Concept analysis, hot issues and research Trends of home care. Social Security Research, 2018, (05): 56-63.
[5] Yifei Z . Construction of a Digital Elderly Care Service System Based on Human-Computer Interaction from the Perspective of Smart Elderly Care [J]. Computational Intelligence and Neuroscience, 2022, 2022 1500339-1500339.
[6] Chen Chunliu, Zhuang Lifen. Construction logic, challenge and approach of smart elderly care Service System: Based on a case study of future Health care and Wisdom City in L District of Z Province [J]. Theoretical Observation, 2024, (09): 98-104.
[7] Zuo Meiyun. Connotation, model and Opportunity of smart elderly care [J]. China Public Security,2014(10):48,49.
[8] Wang Qingde. Research and countermeasures of "smart elderly Care" model in China [J]. China Economic and Trade Guide, 2021(03):155-157.
[9] Zhang Lei, Han Yongle. The main models, existing problems and countermeasures of intelligent elderly care in China at present. [J]. Social security research, 2017 (02) : 30 to 37.
[10] CAI Xiaoshen, Tian Yujing. Analysis of cooperation mechanism of intelligent elderly care model based on actor model [J]. Journal of Theoretical Research, 2017(05):13-19.
[11] Wu Yuxia, Waring Road. Analysis on the service model of intelligent elderly care in China -- taking Yangtze River Delta as an example [J]. Journal of Ningbo Institute of Technology,2016(03):59-63+76.
[12] Liang Changyong, Hong Wenjia, Ma Yiming. Global old-age care: a new development model of smart old-age care in the new era [J]. Journal of Beijing Institute of Technology (Social Sciences), 2022,24(06):116-124.
[13] Deng Rong, Wang Zheng, Shi Hua Wei, et al. Research summary of Trinity's Chinese smart health care service design system [J]. Packaging Engineering, 2025, 46 (04): 77-95+14.
[14] Sun X . Analysis of China's Smart Elderly Care Service Policy: Based on the Three-dimensional Framework [J]. SAGE Open, 2024, 14 (1):
[15] Liu Zhangwei, Huang Jiaqin, HANG Xinyu, et al. A comparative study on modern pension models [J]. Theoretical Observation,2024(9):105-111.
[16] The 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Outline of the Vision Goals for 2035 [N]. People's Daily,2021-03-13(001).
[17] Liu Xiaolin, Wu Qi, Ren Wei. Research on the development of intelligent elderly care industry in China: Current situation, problems and countermeasures [J]. China Collective Economy,2024(12):17-20.
[18] Liu Tian-Chang, WANG Lei, ZHU Qinghua. Research on User churn prediction of smart home elderly care Service Platform based on SHAP interpretation method [J]. Data Analysis and Knowledge Discovery, 2018,8(01):40-54.
[19] The State Council. Notice of The State Council on the Issuance of the 14th Five-Year Plan for the Development of National Undertakings for the Aged and the Plan for the Elderly Service System [J]. Bulletin of The State Council of the People's Republic of China,2022(7):13-29.
[20] Zhou Yimin, YAO Yuzhe, Ye Xuchun. Study on the quality of acceptance attitude of elderly care robots based on value perception [J]. Nursing Research, 2025, 39 (03): 381-387.
[21] Zhang Ze Hao. Driving factors, transformation logic, practical dilemmas and countermeasures of wisdom-enabled elderly care services [J]. Journal of Xi 'an Jiaotong University (Social Sciences Edition), 2019,44(03):64-74.
[22] Liyakathunisa ,Abdullah A ,Saima J , et al. Ambient assisted living framework for elderly care using Internet of medical things, smart sensors, and GRU deep learning techniques [J]. Journal of Ambient Intelligence and Smart Environments, 2022, 14 (1): 5-23.
[23] Bai W . Research on Harbin Smart Community-based Elderly Care Services[C]// Northeastern University. Proceedings of the 2nd International

Conference on Interdisciplinary Humanities and Communication Studies（part2）. Harbin Institute of Technology;, 2023: 6.

[24] Hong D, Lee SH. Effectiveness of the non-face-to-face comprehensive elderly care application "smart silver care" for community-dwelling elderly: A randomized controlled trial. Digit Health. 2023 Aug 24;9:20552076231197340.

[25] Chen Youhua, Shao Wenjun. Smart elderly care: Connotation, dilemma and Suggestions [J]. Jianghuai Forum,2021(2):139-145.

[26] Zhang Yanfang. Analysis on the development of smart community home care service model [J]. Human Resources Development,2022(3):51-53.

[27] Zhang Kexin. Research on key issues in the development of smart home care service industry [J]. China-arab States Science and Technology Forum,2022,(08):107-110.

[28] Tang Linlin. A Preliminary study on the home-based intelligent elderly care model of "Industry Committee + Property Management" under the background of Jiangsu community [J]. China Market, 2025, (03): 15-18.

[29] Milre. Intelligent home endowment service precision chemical exploration [N]. Henan by the news, the 2024-11-12 (012). 10.28362 / n.c nki. NHNCX. 2024.002158.

[30] Sui Yubo. Qing Meng: An IT-oriented model of smart pension for the whole business chain [J]. China Social Work,2017(14):22-23.

[31] Sheng Jie.Opportunities, Challenges and Path Selection of the whole chain development of silver hair economy in Henan Province [J]. Journal of Henan Institute of Animal Husbandry Economics, 2023, 36 (04): 23-28.

[32] Wang Wei, Yan Jia. Smart home care for the Elderly: All-factor Service Design in O2O model [J]. Times Economic and Trade,2023,20(1):144-149.

[33] Qin, HuiboaCAa;Li, QuanlinaCAb.Exploring factors influencing the adoption of smart elderly care products: An enhanced UTAUT model analysis of smart wearables[J].Edelweiss Applied Science and Technology.2024,Vol.8(No.5)：954-966.(5) 1796

[34] Hung J. Smart Elderly Care Services in China: Challenges, Progress, and Policy Development. Sustainability. 2023; 15(1):178.

[35] He Li-Fang, Li Xiao-Ying, Li Chun-Yan, et al. A Comparative study on humanistic Care Behavior of nursing staff and Care needs of the elderly [J]. Journal of PLA Nursing, 2019, 36 (10): 36-39.

[36] Pang Hui, ZHAO Fengyi, Zhu Shujuan, et al. A qualitative study on the experience and needs of the home-based elderly in intelligent nursing care [J]. Shanghai Nursing, 2025, 25 (02): 34-39.

[37] Zhang Chenggang, Ning Xuesi. Generation logic and practice path of smart elderly care in grassroots communities: A case study based on TOE framework [J/OL]. Journal of Public Administration,1-15[2025-02-26].

[38] Lin Lu. Research on the Design of Intelligent Health Care System from the Perspective of Micro-needs [D]. China Academy of Art, 2022.

[39] Ning Ruohong. Give full play to Shenzhen's advantages and walk in the forefront of the intelligent era [N]. Shenzhen Special Zone Daily, 2025-02-26 (A02).

[40] Sun Jie, ZHANG Lei, XU Huiyao. Representatives and members focus on the new era of elderly care [N]. Beijing City Deputy Center News, 2025-01-14 (002).

[41] Zhao, Wen & Foo, Lokemin (2024) A Literature Review of China's Smart Elderly Care Industry SSR 6(5) 6902

[42] Xiao, Y., A Study on the Willingness of Elderly People to Adopt Smart Elderly Care Services and Products. Lecture Notes in Education Psychology and Public Media 25 117 (2023).

[43] Lu Jing. Analysis of current situation and optimization path of digital elderly care service construction in the digital era [J]. Times Economic and Trade,2025,22(02):162-164.

[44] Fan Hongmin, WANG Ke, Li Xiaofang, et al. Driving factors, barriers and paths of elderly care service innovation in the new era [J]. Social Policy Research,2020(4):26-38.

[45] Mao Q ,Mao Y ,Sun Q , et al. Smart transition pathways and development incentive mechanism of China's smart community elderly care industry under market dominance: Considering a multi-subjective behavior game. [J]. PloS one, 2024, 19 (5): e0297696-e0297696.

[46] Miao Xiaona, Hang Jiamin, Lin Jiale. Analysis of the development dilemma of the combination of medical care and nutrition in China under the strategy of Healthy China [J]. Chinese Medical Ethics,2023,36(12):1364-1369. (in Chinese)

[47] King chan. Under the background of aging population of wisdom that occupy the home city endowment study [J]. Journal of wind science and technology, 2023, (33) : 162-164. The DOI: 10.19392 / j.carol carroll nki. 1671-7341.202333053.

[48] Shan Shuo. Strategy research of community work involved in smart home care service [J]. Journal of Weifang University,2023,23(4):74-77.

[49] Wang Rui, Jiang Qing-Dan, Ma Yue-dan, et al. Study on health care model of smart community under the perspective of combination of medical and nursing care [J]. Chinese Journal of Social Medicine, 2025, 42 (01): 10-14. (in Chinese)

[50] Pan Qin-Chun, Wu Di, Fu Xing-Li, et al. Training path of professional ability of intelligent and healthy talents under the background of integration of production and education [J]. Sichuan Labor Security, 2024, (12): 127-129.

[51] Li Xinxin. Research on Optimization of intelligent home care service system [J]. Cooperative Economy and Technology,2023(21):175-178.

[52] Zhu Y Y. Accelerate the expansion and optimization of smart home care services [J]. Science and Technology Finance,2023(7):21-26. (in Chinese)

