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The Real Dilemmas and Promotion Paths of Embedding Digital Technology in Community Sports and Health Services for the Elderly

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Abstract

Against the backdrop of an accelerating aging population, embedding digital technology into community sports and health services for the elderly has become an important approach to enhancing service efficiency. At present, the population aged 60 and above in China has reached 310.31 million, accounting for 22%. As the main activity space for the elderly, the digital transformation of sports and health services in communities is in urgent need. Based on the theory of technology embedding, this study systematically analyzes the practical predicaments in the process of digital technology embedding through literature analysis, field research and expert interviews, including insufficient technology adaptability, fragmented data governance, resistance to service process reconstruction, lack of organizational collaboration mechanisms, and the digital divide among elderly users. The research proposes to construct a three-dimensional embedded model of "technology - service - user", and designs the promotion path from five dimensions: standard system construction, service process innovation, elderly-friendly technology transformation, multi-party collaborative mechanism, and digital literacy cultivation, providing theoretical references and practical guidance for promoting the deep integration of digital technology and community sports and health services.

Keywords

Digital technology Elderly people; Community sports and health services Community sports and health services for the elderly.

1. Introduction

1.1. Research background and significance

The Third Plenary Session of the 20th Central Committee of the Communist Party of China mentioned that it is necessary to integrate the concept of positive aging and healthy aging into the entire economic and social process, strengthen and improve the work on aging, and promote the cause of aging. In recent years, with the rapid development of economy and society, China's population structure has undergone significant changes, and the trend of population aging will become more obvious. According to the data released by the state in January 2025, the number of people aged 60 and over is 310.31 million, accounting for 22% of the national population, of which the number of people aged 65 and over is 220.23 million, accounting for 15.6% of the national population. my country's aging level is increasing. Continuously deepening, the situation is grim. The "silver tide" is coming with an irresistible momentum. According to statistics, there are more than 190 million elderly people suffering from chronic diseases in my country, and about 40 million disabled and semi-disabled elderly people. Under this realistic background, the health of the elderly has become a The core issue of building a healthy China. The "14th Five-Year Plan for Healthy Aging" clearly states that it is necessary to

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"build a health service system for the elderly covering urban and rural areas"; The "Decision" of the Third Plenary Session of the 20th Central Committee of the Communist Party of China regards "implementing the health priority strategy" as an important starting point for national governance, with special emphasis on "improving the national fitness public service system" and "promoting the integration of sports and health"; The 2024 "National Fitness Facilities Improvement Action Work Plan (2023-2025)" clearly requires "strengthening the allocation of fitness facilities suitable for aging and children". All these provide policy anchors for the health management of the elderly. However, the actual contradictions are still prominent: the coverage of sports facilities suitable for the elderly in communities across the country is insufficient, the community implementation of sports and health integration services is low, and the elderly are facing multiple factors such as "facilities cannot be used, services are not accurate, and data is not interoperable". Reconstruct the service system at the strategic level. The "14th Five-Year Plan for the National Aging Cause and Elderly Care Service System" clearly proposes to "promote the deep integration of information technology and elderly care services", and the embedding of digital technology has become a key breakthrough to solve the problems of low service supply efficiency and insufficient personalization. Compared with "digital intelligence empowerment", "digital technology embedding" puts more emphasis on the organic integration of technology and service systems, and pays attention to the penetration process of technology applications from the tool level to the service ecological level. In the current community sports and health services, the application of digital technology is still at a shallow level such as equipment laying, and has not yet achieved deep coupling with service processes, organizational structures, and user habits, making it difficult to fully release technical efficiency. This article adopts the framework of "theoretical analysis-current situation investigation-problem diagnosis-path design" to deeply discuss the reality and promotion path of digital technology embedded in community sports and health services for the elderly, which is of great importance to the construction of intelligent, precise and personalized community sports and health services for the elderly. Services have important theoretical value and practical significance.

1.2. Theoretical basis and research status

1.2.1. Digital Technology Embedding Perspective

In 1944, Karl Polanyi proposed the concept of "embeddedness" to reveal the interactive relationship between the economy and the social structure. "Embedding" is the coupling and coordination between various elements, rather than the unilateral action or mechanical combination of the embedding subject [1]. Embedding digital technology into community sports and health services for the elderly involves two-way adjustment of technical systems and service systems: on the one hand, technology needs to be adapted to the needs of elderly users; On the other hand, the service process and organizational structure need to be restructured due to the introduction of technology. In this process, there may be multiple tensions of "technology-organization-user", such as the contradiction between technical standardization and service personalization, the conflict between data sharing requirements and organizational barriers, etc.

1.2.2. Research Progress

At Home and Abroad Foreign research focuses on the integrated application of intelligent technology in elderly health services. For example, the "Healthy Aging Research Initiative" project in the United States improves the life and healthy life of the elderly through intelligent health monitoring systems and data-driven health management. The EU "eHealth Network" emphasizes the need for technology embedding to follow the "user-centric" principle. It educates patients and encourages a hands-on, proactive approach to managing all aspects of health, providing a personalized approach to maximize Improve care and connect between

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visits. In the pilot community in Munich, Germany, through the participation of the elderly in technical design, the utilization rate of smart sports equipment has increased by 40%. In recent years, domestic research has gradually expanded from the level of technology application to the level of system integration. Scholars have conducted effective explorations in coastal cities, such as: Zhejiang "People's Gym" mentioned by Professor Xin's team, Shanghai "Elderly Sports Home", etc. These cases have accumulated valuable experience for the practice of this study [2]. Scholars have pointed out that under the background of driving digital technology innovation and upgrading citizens' living needs, digital intelligence technology has contributed new momentum and new elements to the high supply of community sports and health services. Some scholars have proposed a three-dimensional integration model of "technology-service-management", but there is insufficient discussion on deep-seated issues such as organizational resistance and user acceptance mechanism in the embedding process, especially the lack of embedding path research based on service process reengineering.

1.3. Research Methodology Literature analysis

Search the literature, journals, newspapers and other materials with the keywords of "digital technology", "elderly" and "community sports and health services" in the largest range of CNKI, VIP, Web of Science, etc., collect and sort out various literature materials, sort out the theoretical basis of relevant research, provide academic research support and demonstration materials for this study, and improve the scientificity, value, and pertinence of the project research. Expert interview method: In the early, middle and late stages of empirical analysis and research, interview about 6-10 leading experts in medicine, information management, community services, etc. for Delphi consultation, determine key dimensions and path priorities, and understand and grasp "digital intelligence technology" The judgment and basic viewpoints of the "sports and health services for the elderly" measures, combined with various health elements, resources, information, degrees, and multi-level discussions. Field research method: Select two typical communities and community health service institutions in the eastern, central, and western regions to conduct field research, observe the application scenarios of digital intelligence technology in community sports and health services, and record the actual situation of equipment configuration, data collection, and service processes. Case analysis method: Collect typical cases of digital technology embedded in community elderly care services at home and abroad, such as: Shanghai "Elderly Sports Home", Ningbo Yinzhou "Good Community" Smart Sports and Health Center, Wenzhou "People's Gym", New York "Silver Sneakers" Plan and others to extract lessons from success and failure.

2. The reality of digital technology embedded in community sports and health services for the elderly

2.1. Insufficient technology adaptability: the fault from "functional supply" to "demand matching"

At present, the application of digital technology in community sports and health services has an obvious "technology-based" tendency, and the functional design of equipment is out of touch with the needs of elderly users. According to the survey, most community smart sports equipment has not been optimized by body engineering for the elderly. For example, the height of the operation panel of a certain brand of smart treadmill is 1.4 meters, which exceeds the comfortable operation range of the elderly over 70 years old (1.1-1.3 meters); Health monitoring equipment uses touch interaction and does not consider the characteristics of decreased finger flexibility in the elderly. At the software level, most sports and health apps have complex interfaces. A mainstream App needs to click on a level 5 menu to query sports data, resulting in more than half of the elderly unable to obtain data reports independently. Due

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to different community economies, age classes and other reasons, elderly users have different data on personal physiology, psychology, exercise habits, and medical treatment. Elderly users need targeted personal exercise plans and services, while most communities provide sports courses such as square dancing and aerobics. and other collective activities, the curriculum design does not fully consider the physical condition, exercise basis and interest preferences of the elderly. This fault between "functional supply" and "demand matching" makes technology embedding stay at the physical level and difficult to transform into service efficiency.

2.2. Data Governance Fragmentation: "Digital Barriers" for Cross-Domain Collaboration

The core value of digital technology embedding lies in data-driven service optimization, but the current data governance of community sports and health services presents significant fragmentation characteristics. The physical health data of the elderly mainly relies on manual entry or collection by a single device, which is prone to data errors. Because the physical fitness monitoring data of the sports department, door health records, and community service records belong to different systems, data loss and data impairments are prone to occur. For example, the intelligent body testing equipment in a pilot community is incompatible with the HIS system interface of the community hospital, resulting in the inability to communicate with the health data of some elderly people. The problem of inconsistent data standards is particularly prominent. The accuracy of heart rate data collected by sports equipment of different companies varies by ± 10 beats per minute, and there is a phenomenon of mixed use of mmHg and kPa in blood pressure data units. Data security management is also an important practical issue, and there are hidden dangers in the information protection of the elderly. The personal information and health data of the elderly stored in the community sports health service system belong to information, but most communities lack perfect data encryption and access control mechanisms. Even some smart device manufacturers have the risk of data abuse, and use sports data for commercial promotion without the consent of users, which further strengthens the trust of the elderly in digital technology. This "digital barrier" not only leads to the lack of data security, but also makes it difficult to achieve accurate data-based services. For example, the exercise intensity recommendations for the elderly with diabetes are not accurate due to the lack of blood sugar data support [3].

2.3. Resistance to Service Process Restructuring: "Organizational Inertia" of Technology Embedding

There is an internal conflict between the community sports health service process and the logic of digital technology, forming the "organizational inertia" resistance of technology embedding. In the process of providing services, manual registration, paper files and other operations are parallel to the digital management system. A community worker needs to maintain the paper sign-in form and the electronic management system at the same time, resulting in a high rate of duplication of labor. In the service evaluation process, there is a lack of a digital effect tracking mechanism. Most communities still use questionnaires to collect service feedback, and the data lags behind and is difficult to quantify. In terms of organizational structure, there is a division of functions among communities, health service centers, and sports and fitness institutions, and there is a lack of unified data interaction standards, resulting in the inability to share information such as exercise data, health records, and living habits of the elderly across departments. Medical staff cannot obtain the exercise data of the elderly to formulate personalized health intervention plans, and it is also difficult for exercise instructors to know the medical history information of the elderly, which poses a major service safety hazard. This "fragmented" organization seriously restricts the depth of technology embedding.

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2.4. Lack of synergy among multiple subjects: the "synergy vacuum" of the embedding process

Digital technology embedding is a systematic project involving multiple subjects such as enterprises, communities, and families, but there is currently a lack of effective coordination mechanisms among various subjects. There is a tendency of "emphasizing hardware procurement and ignoring service integration" in the department. A prefecture-level city invested 3 million yuan to purchase community smart devices, but did not establish a cross-departmental data sharing platform; Enterprises pay attention to equipment sales and ignore follow-up technical training and system maintenance, resulting in some community smart devices being idle due to faults and unrepaired; The absence of family support roles and the lack of child guidance for most elderly people when using smart devices exacerbate technology use barriers. This kind of "collaborative vacuum" makes technology embedding fall into "individual advance", and it is difficult to form a joint service force. The multi-subject collaborative talent training system is not perfect, and there is a serious shortage of talents in the field of community sports and health services, presenting the double of "insufficient quantity and unreasonable structure". Most of the existing talents have a background in physical education, but they lack interdisciplinary knowledge such as medicine and digital technology, and it is difficult to meet the needs of digital and intelligent services. There is an extreme shortage of compound talents who understand both sports rehabilitation and operate smart devices [4].

2.5. The digital divide of elderly users: the gap from "technology available" to "technology can be used"

The final effect of digital technology embedding depends on the degree of acceptance and use by elderly users, but there is currently a significant "digital divide". The lack of aging-friendly digital intelligence products is a key factor restricting the willingness of the elderly to use them. Most of the existing digital products are designed for young and middle-aged groups, with complex operation interfaces and redundant functions, which are obviously out of touch with the cognitive ability and usage habits of the elderly. According to the survey, the usage rate of smart devices for the elderly over 65 years old is low, and the vast majority of the elderly refuse to use them because of "fear of operational errors"; Among the elderly with basic operating capabilities, only a small number can fully use the health analysis function of the device. At the same time, the device lacks the necessary interaction, strong light reminder and other elderly-friendly functions. For example, the screen font size of a certain brand of smart body fat scale is only 12px, which is difficult to recognize in low light [5]. On a deeper level, this gap is not only a lack of operational skills, but also a lack of digital literacy. For example, the elderly have limited ability to understand exercise data, and most elderly people cannot interpret the "maximum oxygen uptake" in the physical test report. "and other professional indicators, resulting in barriers to use of technology embedding at the user level.

3. The promotion path of digital technology embedded in community sports and health services for the elderly

3.1. Constructing a standard system: the transition from "technology stacking" to "system integration" Establishing a unified technology embedding standard system is the basis for system integration.

At the hardware level, the "Standards for Aging of Community Sports and Health Service Equipment for the Elderly" has been formulated, which clearly stipulates physical parameters such as equipment height, operating power, and display interface. For example, the height of the operation panel of smart fitness equipment should be ≤ 1. 3m, and the size of the button

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should be ≥ 25 mm × 25 mm. At the data level, compile the "Community Sports and Health Data Interaction Specification" to unify data collection items, formats and transmission protocols. You can refer to the HL7FHIR standard to build a personalized sports and health portrait model for the elderly to realize the semantic interoperability of physical fitness monitoring, sports records, and health files. At the service level, the "Digital Technology Embedded Service Process Specifications" clarifies the standards for the entire process from data collection, analysis to intervention. For example, it is stipulated that sports risk assessment must be based on at least 3 months of continuous health data. The formulation of the standard needs to introduce the participation of representatives of elderly users to ensure the applicability of the standard. To establish a comprehensive data security guarantee system, the community needs to implement the main responsibility of data security, deploy network security equipment such as firewalls and intrusion detection systems, add data transmission, establish a data classification and classification management system, and list the health data of the elderly as high-level Protect information, strictly restrict data export and external sharing. Regularly carry out data security training and emergency drills to improve staff's safety awareness and handling capabilities. At the same time, a third-party audit institution is introduced to conduct regular compliance reviews of the data management process to ensure compliance with laws and regulations such as "Personal Information Protection" [6].

3.2. Innovative service process: "organizational adaptation" of technology embedding Service process innovation is a key measure to break through organizational inertia.

Build a new "data-driven" service process: collect sports and health data in real time through smart terminals (such as wearable devices, community intelligent body measurement stations) at the front end, and automatically upload them to the community sports and health cloud platform; Zhongtai uses AI algorithms to clean and analyze data, and generate sports and health portraits of the elderly, such as identifying the elderly group with "knee degenerative lesions and sedentary habits"; The back end automatically matches the intervention plan according to the portrait, pushes it to community sports instructors and the elderly, and recommends water rehabilitation sports courses for the above groups. At the same time, the organizational structure was restructured, a "digital service cooperation group" composed of community neighborhood committees, health service centers, and sports associations was established, and a full-time data administrator position was set up to be responsible for cross-departmental data coordination and service process optimization.

3.3. Promoting the transformation of aging-friendly technology: the transformation from "universal design" to "silver-haired customization"

The transformation of aging-friendly technology needs to be embedded throughout the entire chain of technology. The hardware design follows the principle of "minimalism" and adopts the combination of "one-button" physical buttons and interaction. For example, a smart bracelet suitable for aging only retains three physical buttons of "health monitoring", "emergency call" and "child contact". Instructions to realize function switching; The display adopts a high-definition screen of more than 1.78 inches, with a font size ≥ 18px, and supports clear display under strong light. Software design focuses on "cognitive burden reduction" and simplifies complex functions. For example, motion data reports adopt "traffic light" visual design (green normal, yellow warning, red alert) to replace technical terms; The interactive process is controlled within 3 steps, and the operation guides the animation; Put common functions (such as sports recording, health monitoring) in a prominent position on the homepage, and cancel pop-up windows and complicated operation steps. In particular, it is necessary to strengthen the "fault-tolerant design" of the technology, set up a false touch cancellation function, an operation backtracking mechanism, and the anxiety of the elderly.

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3.4. Establishing a Multi-Synergy Mechanism: "Ecological Construction" of Embedding Process

Build a collaborative ecology with leadership, enterprise participation, community implementation, and family support. At the level, establish a cross-departmental coordination group composed of civil affairs, sports, and health departments, formulate a technology embedding roadmap, and incorporate indicators such as data sharing rate and equipment utilization rate into the community assessment system; Set up a "special fund for digital technology embedding", and allocate funds according to the ratio of "30% for equipment procurement, 50% for service operation, and 20% for talent training". Enterprises need to transform from an "equipment supplier" to a "service solution provider", not only providing hardware, but also responsible for system docking, personnel training and post-maintenance, and can adopt the business of "purchasing services and paying for service volume". The community plays the role of "hub", establishes "technology embedding workshops", and regularly organizes the elderly, enterprise technicians, and service providers to discuss issues together; Families play a "supportive" role. Through the "Family Digital Worker" program, children are trained to help the elderly use smart devices. For example, the "Intergenerational Digital Mutual Aid" activity launched by a community in Shanghai has increased the technology usage rate of the elderly by 27%. A special training fund should be set up, and universities, industry associations and other institutions should be entrusted to carry out systematic training. The training content covers smart device operation, data analysis, communication with the elderly, etc., and the "social sports instructor digital skills" certification system should be implemented to apply digital intelligence technology. Ability is included in the instructor assessment system to encourage them to learn actively. For example, the "Smart Fitness Instructor" training project launched in Beijing has trained thousands of professionals with digital intelligence service capabilities through the combination of online theoretical learning and offline practical assessment.

3.5. Fostering Digital Literacy: Capacity Building to Crossing the "Use Divide"

Build a "hierarchical classification" digital literacy cultivation system. For the young elderly (60-70 years old), carry out basic training on "smart device operation", including core functions such as switching on and off, data query, emergency call, etc., using the combination of "community classroom door-to-door guidance", such as Beijing "Silver Age" Digital School "conducts face-to-face courses twice a week, and distributes the" Manual for Using Smart Devices for the Elderly "with pictures and texts. For the elderly (over 70 years old), focus on cultivating the ability to rely on "digital assistants", guide them to learn to obtain technical support through family children, community volunteers, etc., and establish a "1 N" assistance network (one elderly person corresponds to multiple digital assistants). Integrate the cultivation of "data awareness" into literacy cultivation, and let the elderly understand the value of exercise data through case teaching, such as demonstrating the "correlation between walking data and blood sugar control", and increasing their willingness to actively participate in data collection. The community can popularize scientific sports knowledge to the elderly by setting up health lectures, distributing popular science manuals, organizing experience activities, etc., emphasizing the importance of "sports risk assessment" and "personalized sports programs". Use community bulletin boards, WeChat public accounts and other platforms to regularly publish sports and health cases for the elderly,.

4. Conclusion

Based on the perspective of digital intelligence empowerment, this study systematically analyzed the current situation of community sports and health services for the elderly, revealed the practical difficulties in data management, service supply, technology adaptation, talent

support, and health concepts, and accordingly proposed Targeted advancement path. Studies have shown that the in-depth application of digital intelligence technology is an inevitable choice to improve community sports and health services for the elderly, but it requires the concerted efforts of multiple parties such as enterprises, communities, and families, from the dimensions of policy guarantee, technological innovation, personnel training, and concept dissemination. Build a comprehensive support system.

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