Innovation and Practice of Digital-Enabled Embedded Elderly Care Service Model in Urban Communities

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ABSTRACT

In recent years, China has witnessed rapid urbanization and a significant growth in the urban population. According to the data from the Seventh National Population Census, the permanent urban population in China has exceeded 900 million. With the continuous expansion of urban scale, the functional requirements of urban communities have become increasingly diversified. However, many traditional community service facilities suffer from irrational layout, leading to problems such as massive resource waste and inability to meet the living needs of residents. This paper focuses on the embedded elderly care services in urban communities and explores the core role of digital empowerment in the innovation of service models.

KEYWORDS: *Embedded Community; Digital Community; Smart Elderly Care; Innovation; Practice.*

I. The Demand Significance of Embedded Community Construction and the Innovation of Smart Services in China

From the demand side, this paper analyzes the strategic significance and practical orientation of constructing embedded communities in China. An embedded community is a type of community integrated into urban space, which reasonably arranges community services by integrating with the urban space and represents a new direction suitable for the development of urbanization. The innovative service model of embedded communities relies on a smart service platform to build a service ecosystem. With the platform as the core, it integrates various service resources such as medical care, elderly care, and housekeeping services, and unifies the scattered service stations at different locations within the community to form a digital and intelligent management system. This breaks down the information barriers and service boundaries between different services. The elderly and young groups can make reservations and place orders for relevant services through multiple online channels such as mobile Apps, mini-programs, and intelligent terminals, as well as various offline methods including phone reservations and on-site visits. For example, the elderly can make reservations via mobile Apps, mini-programs, or phone calls. Once an elderly person presses the help button on the smart bracelet, the platform will quickly link the surrounding medical institutions and community volunteers to provide emergency medical care and daily care services simultaneously. Young people, on the other hand, can make reservations for housekeeping and cleaning, home appliance maintenance, etc., through Apps or mini-programs, and the system platform will select high-quality service providers for connection. Eventually, an innovative community service system featuring "online + offline" and "demand response + active service" is formed. This system not only provides the community with a warmer service experience and higher-quality and more efficient services but also truly improves the quality of life of community residents. It also highlights the strategic significance and practical value of embedded communities in

meeting the diverse needs of residents and promoting the upgrading of community service models [1][6].

II. From Concept to the Reconstruction of Technical Logic

A. Conceptual Expansion of Community-Embedded Elderly Care

Community-embedded elderly care service is not a simple "service superposition" but an organic empowerment process that transforms the community into a "living entity". The "Space-Service-Relationship" three-dimensional nested model proposed by Zhao Yu [8] elaborates on this: from the spatial dimension, it breaks through the physical space constraint of the day care center and extends to the idle properties within the community, such as rehabilitation stations converted from old garages; at the service level, it changes the inherent "menu-style supply" model and establishes a "demand-triggered" model to achieve timely rescue. This enables elderly people living alone to link multiple resources such as medical care and voluntary services with a single call. Meanwhile, community residents are encouraged to actively participate in the service provision process, transforming from "service recipients" to "mutual assistance participants" [2].

B. Theoretical Analysis Dimensions of Digital Empowerment

1. Breaking the Temporal and Spatial Cocoon of Services

From the perspective of theoretical analysis, digital empowerment can break the temporal and spatial cocoon of services, and the differences in the focus of digital empowerment are important divisions in its theoretical analysis. If community-embedded elderly care is regarded as a "digital ecosystem", then its blood vessels are the "digital blood" transmitted by information and communication technologies. It is reported that a "5G + Smart Monitoring" system in a community in Hangzhou transmits information such as the heart rate of elderly people living alone to community doctors via 5G. However, this also reveals the difficulty of technology popularization: many communities in the western region have not yet completed the upgrading process and have not installed new communication devices, with 4G still being the main network mode. Due to the relatively slow speed of 4G, elderly care centered on humans remains an important way of life for the elderly in society at present [4].

2. Precision of Data Boundaries

The practical experience of Nanshan Community in Shenzhen shows that by counting behavioral data such as the number of times the elderly use the toilet and turn over at night, it is possible to accurately determine whether they are disabled. However, the excessive collection of behavioral data has also aroused public doubts: an elderly person was once forced by their children to be hospitalized because the platform issued a "disability warning". This fact warns us that data analysis must never cross the bottom line of humanity. Therefore, it is necessary to clarify the judgment boundaries for the collection of health data and behavioral data, and while providing accurate services, adhere to the bottom line of respecting human values.

3. Evolution from "Perception" to "Cognition"

At present, the understanding of the Internet of Things (IoT) has gradually deepened - the IoT is no longer just a "collection of sensors". Taking the "HarmonyOS Connected Elderly Care Scenario" in Wuxi as an example, it can simultaneously detect the elderly's heart rate and breathing during sleep, and use a pressure distribution algorithm to identify abnormal body positions of the elderly while sleeping, assess the risk level, and trigger an alarm in a timely manner. In addition, the door and window sensors are linked with the elderly's behavior model. When the elderly's doors and windows have not been opened for 24 hours and the indoor activity volume remains zero, the system will trigger a guardianship danger alarm.

III. Exploring a New Model of Digital-Enabled Community-Embedded Elderly Care

A. Building the Foundation with Technical Means

Firstly, the foundation is built through technical means, that is, the deployment of a "perceptual neural network" deeply embedded in the fabric of the community. Various intelligent terminal devices have gradually expanded and evolved into diverse forms that can form deep connections with the environment. Intelligent terminals such as millimeter-wave radars, infrared sensors, smart mattresses, water immersion/smoke/fall detectors no longer operate independently. Instead, they send real-time data to the cloud platform in an encrypted manner through IoT protocols or home gateways. After connecting service points within the community, such as elderly care service stations, community health service centers, elderly activity centers, and convenience stores, to the same platform, a physical and service scenario twin mapping of online and offline is formed. The big data platform serves as the base of this "smart brain". It uses stream processing and batch processing technologies to complete business operations such as cleaning, integration, storage, and analysis of massive heterogeneous data at any time, laying a strong data foundation for the realization of precise services.

B. Precise Smart Services

Relying on the big data base and intelligent algorithms, precise and proactive smart elderly care services can be provided in the following ways: Firstly, push personalized reminders and online consultations to the elderly's intelligent terminals or the family members' APPs; Secondly, synchronously notify the family doctors of the community health service centers to conduct health follow-ups or arrange trained community elderly care assistants with professional knowledge to visit and provide psychological comfort. In terms of daily care, meal preparation can be provided, and an online "one-click reservation" meal delivery function is available. Through the linkage between the intelligent medicine box and the platform, when the elderly forget to take their medicine, real-time reminders can be sent to the guardians. The spiritual comfort service has also become more diversified due to digitalization. The platform can provide the elderly with functions such as matching with relevant interest groups, matching with nearby community activities, and reserving volunteer companionship for chat. It also helps the elderly with limited mobility to "visit" museums online or listen to music online. The entire process can realize a complete closed loop of convenient online reservation, traceable service process, and quantifiable evaluation results [5].

C. Integration and Support of Multi-Party Platforms

The integration of multi-port service providers and digital empowerment has brought about a significant change in the relationship between service providers and service recipients, promoting the digital empowerment service model to build a new community elderly care service ecosystem covering multiple subjects. The integrated information platform is a "super hub" supporting the efficient operation of the diversified elderly care service system. Family members have bid farewell to the passive service acceptance model. Through relevant ports, they can check the elderly's safety status, health dynamics, and daily service details in real time online. The remote video call allows family members to communicate face-to-face with the elderly anytime and anywhere. They can also flexibly make online reservations for services according to the elderly's needs, determine the specific content, quantity, and frequency of service items, and finally form an adapted elderly care plan. In addition, family members can check all past service records and complete the evaluation and scoring. Professional service institutions can rely on the platform to obtain needs more accurately, match resources more efficiently, and manage services more standardizedly,

thereby promoting the improvement of their own operation level and service quality. The management level of volunteer organizations will also be higher. Using the platform, they can publicize volunteer needs, match volunteers' skills and time, record service hours, and provide incentive feedback, which is conducive to improving the regularity and accuracy of voluntary services. For institutions such as community neighborhood committees and property management companies, based on the data analysis of the above-mentioned platform, they can better plan the elderly care facilities in the community and the development of elderly activities, and accurately carry out safety risk investigation work, thereby improving the refined governance level of the community [7].

IV. Challenges and Countermeasures of Digital-Enabled Community-Embedded Elderly Care Services

A. Three Major Challenges Faced by Digital-Enabled Community-Embedded Elderly Care: Technology Popularization, Data Security, and Digital Divide

Facing the three major pain points of technology popularization, data security, and digital divide in the digital-enabled community-embedded elderly care services, a lot of work still needs to be done in the process of integrating digital technology into community-embedded elderly care services: Firstly, the difficulty of technology popularization is high. Some community elderly care service institutions have limited funds and find it difficult to bear the costs of purchasing intelligent equipment, maintaining intelligent equipment, and hiring professional and technical personnel. Some elderly people have not fully accepted new products such as smart wearable devices and online service platforms, and a few elderly people cannot accept digital elderly care services because they fail to master the use of intelligent equipment. Secondly, the hidden danger of data security is significant. Elderly care service data includes the elderly's health status, living habits, family information, etc. Once the elderly care service data is leaked, tampered with, or illegally used, it will bring serious risks of personal information leakage to the elderly, leading to property losses and the loss of trust in community elderly care service institutions. At present, many elderly care service institutions still lack technical support and institutional norms for data security protection, as well as data encryption, storage, and access permission control. Thirdly, the digital divide among the elderly widens the inter-generational service gap. Elderly people who are young and highly educated are willing to accept new technologies and try to use digital tools to seek

services. However, elderly people who are old and less educated find it difficult to cross the technical threshold, resulting in unfair distribution of elderly care resources. Some groups are even excluded due to their unfamiliarity with digital life [3].

B. Addressing the Dilemma Requires Multi-Dimensional Measures in Technology Adaptation, Security Protection, and Resource Coordination

To address these issues, technically, it is necessary to achieve faster integration, more comprehensive coverage, and more orderly promotion; institutionally, it is required to establish more complete systems and implement them more effectively; in terms of collaboration, it is necessary to organize more fully and promote more efficiently. In addition, relying on the guidance of the government, we should link communities, universities, and technology enterprises to establish a "one-on-one" or "small-class" smart elderly care service training team, carry out smart operation teaching, and produce video materials such as graphic operation manuals and smart life micro-courses, making it easy for the elderly to master and willing to accept. Enterprises are encouraged to develop aging-friendly digital products with simplified interface designs and more convenient voice interaction functions for the elderly, so as to improve the usability of elderly care services. Improve the data security protection system. Relevant departments should issue special regulations on the management of elderly care service data, clarify the scope, boundaries, and subjects of data collection, storage, and sharing. Promote the use of technical means such as blockchain and encryption algorithms. Elderly care service institutions should build a data security protection system that integrates full-chain data traceability and full-link data monitoring, and regularly conduct data security risk detection and emergency response drills.

In the future, the community-embedded elderly care service enabled by digitalization will take technology as a bridge to connect service supply and demand. While solving the problems of traditional elderly care, it will provide an innovative path for actively responding to population aging and help realize the goal of "ensuring the elderly have a sense of security, reliance, and happiness in their old age".

References

[1] Hu, Y. M. (2024). Study on the Optimization of the "Embedded" Elderly Care Service Model in Tianjin Communities [Master's Thesis]. Tianjin University of Finance and Economics.

[2] Fu, Q. (2023). Analysis on the Strategies of "Medical-Nursing Combination" Embedded Community Elderly Care Architectural Design. *Jushe*, (27), 72-75.

[3] Chen, X. Y. (2023). Study on the Problems and Countermeasures of the "Embedded" Community Home-Based Elderly Care Model in Hefei [Master's Thesis]. Anhui Jianzhu University. https://doi.org/10.27784/d.cnki.gahjz.2023.000 596.

[4] Xie, G. P., Yu, Y., & Mao, L. S. (2022). Exploration of the "Internet + Embedded" Community Elderly Care Model. *Urban Development*, (06), 76-77.

[5] Ding, X., Wang, Y. Z., & Yang, Q. L. (2022). Research on the Innovation and Design of Community-Embedded Health and Wellness Tourism Service Model. *Design*, 35(05), 80-83.

[6] Wei, Y. Y. (2021). Study on the Optimization Path of the Embedded Community Elderly Care Service Model [Master's Thesis]. University of International Business and Economics. https://doi.org/10.27015/d.cnki.gdwju.2021.000 505.

[7] Ren, X. H. (2021). Study on the Model Optimization and Mechanism Design of Effective Supply of Embedded Community Home-Based Elderly Care Services [Master's Thesis]. University of Electronic Science and Technology of China. https://doi.org/10.27005/d.cnki.gdzku.2021.003 973.

[8] Lu, J. R. (2020). Study on the Construction of the Embedded Community Home-Based Elderly Care Service Model [Master's Thesis]. Jilin University. https://doi.org/10.27162/d.cnki.gjlin.2020.0065 72.