

Article

Research on the Innovation of Operation and Management Mode of Smart Elderly Care Service Institutions

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Abstract: With the rapid intensification of global population aging, smart elderly care has emerged as an indispensable and effective solution for modern society to address complex aging challenges. Smart elderly care service institutions, acting as comprehensive entities providing health management, daily care, and psychological support services for seniors, urgently require innovative operational models to enhance service quality and improve the overall living standards of the elderly. This study employs a rigorous mixed-method research approach, systematically selecting six smart elderly care institutions of varying scales in the Yangtze River Delta region as representative samples. Through extensive questionnaire surveys and in-depth qualitative interviews, we comprehensively analyzed current operational models and identified critical industry pain points. The empirical findings reveal widespread systemic issues, including severe service-demand mismatches, significant shortages of specialized technical talent, and unsustainably high operational costs in existing smart elderly care facilities. To address these challenges, the study proposes a comprehensive four-dimensional innovation strategy encompassing intelligent platform development, service process optimization, green sustainable operations, and robust talent system construction. By establishing an advanced Internet of Things (IoT)-based smart elderly care system architecture and implementing standardized service protocols, quantitative evaluations demonstrate that these innovative models can significantly reduce labor costs by 32% while simultaneously increasing overall service satisfaction by 27%. Ultimately, these findings provide highly practical references for standardizing the development of the smart elderly care industry and offer crucial micro-level theoretical support for implementing comprehensive national strategies aimed at addressing population aging.

Keywords: smart elderly care; operational management; information platform; service innovation; aging society

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1. Introduction

With the intensification of global population aging, elderly care has become a significant issue of concern across society. In China, the demand for elderly care services has surged rapidly alongside the accelerated pace of population aging. By the end of 2025, the number of people aged 60 and above in China had reached 296 million, accounting for 21.1% of the total population. Among this demographic, the number of semi-dependent elderly individuals exceeded 48 million, creating a continuous and pressing demand for elderly care services [1]. However, traditional elderly care models face numerous challenges, including insufficient resources, uneven service quality, and a shortage of qualified elderly care professionals. These challenges have highlighted the urgent need for innovative approaches to address the growing demand. Consequently, the development of operational management models tailored to smart elderly care service institutions has become a critical focus. Such models aim to improve service quality, enhance resource allocation, and ensure the well-being of the elderly population.

Smart elderly care refers to the provision of integrated and comprehensive services for seniors through the application of advanced technologies such as the Internet of

Things (IoT), big data, and artificial intelligence. These services encompass a wide range of areas, including health management, home-based care, and social entertainment, thereby addressing both the physical and psychological needs of the elderly. This approach not only prioritizes the physical health of seniors but also emphasizes their emotional and social well-being [2]. The innovative operational management models for smart elderly care institutions involve a multifaceted approach. This includes the continuous updating and upgrading of service content to meet evolving needs, the optimization of service management processes to enhance efficiency, and the integration of resources to ensure seamless service delivery. Additionally, these models incorporate innovative personnel management strategies, such as targeted training programs and the use of technology to support staff in delivering high-quality care.

This study aims to explore innovative operational management models for smart elderly care service institutions. These strategies are designed to enhance service quality, improve operational efficiency, and ensure the sustainability of smart elderly care institutions. By focusing on practical and scalable solutions, the study seeks to contribute to the development of a robust framework for managing smart elderly care services, ultimately improving the quality of life for the elderly population [3].

2. Literature Review and Research Status

Domestic scholars have primarily focused their research on smart elderly care in three key areas [4, 5]. The first category examines technological applications, exploring implementation pathways for technologies like IoT and big data in elderly care scenarios. Establishing a digital elderly care service system requires unified data collection standards to break down information barriers between devices and prevent data silos. The second category investigates service delivery models. Research on remote island elderly care services has demonstrated that a three-tiered service model integrating home-based, community-based, and institutional care can significantly improve accessibility in underserved regions. The third category focuses on operational optimization. A proposed framework for urban-level smart elderly care service platforms highlights that developing inclusive elderly care infrastructure requires collaborative efforts from government, market entities, and social stakeholders. These areas collectively underscore the importance of integrating technology, service delivery, and operational strategies to enhance the effectiveness of smart elderly care systems.

In international research, EU countries have pioneered smart elderly care practices with operational models emphasizing multi-stakeholder collaboration. These models often involve partnerships between public institutions, private enterprises, and community organizations to ensure comprehensive service delivery. In the United States, smart elderly care facilities typically adopt a dual management framework that integrates advanced technology with humanistic care. This approach maintains a high proportion of humanistic service positions while deploying intelligent monitoring equipment to enhance safety and efficiency. Japan's smart elderly care system has established a mature long-term care insurance payment mechanism, which provides stable funding sources for sustainable institutional operations. These international practices highlight the diverse strategies employed globally to address the challenges of aging populations, offering valuable insights for the development of localized smart elderly care systems.

Existing research has validated the advantages of smart elderly care models, yet micro-level studies on institutional operational management remain insufficient. Most studies are limited to the strategy proposal stage, lacking empirical data support and actionable process frameworks [6]. This gap in the literature underscores the need for more detailed investigations into the practical aspects of operational management. Addressing this research gap, the current study employs multi-case surveys to provide concrete practical pathways for operational innovation in smart elderly care institutions. By focusing on real-world applications and challenges, this research aims to bridge the divide between theoretical proposals and practical implementation, offering actionable

insights that can guide the development of more effective and sustainable smart elderly care systems.

3. Research Methods

This study utilized a mixed-method research design that combined quantitative surveys with qualitative analysis to ensure a comprehensive understanding of the subject matter. In the quantitative phase, six smart elderly care service institutions located in the Yangtze River Delta region were selected as representative samples [4]. These institutions included two public entities, two private non-profit organizations, and two market-oriented for-profit establishments, providing a balanced perspective across different operational models. A total of 320 questionnaires were distributed to elderly participants, with 287 valid responses collected, resulting in an effective response rate of 89.7%. Furthermore, 42 questionnaires were distributed to institutional managers, yielding 38 valid responses and an effective response rate of 90.5%. The questionnaire was meticulously designed to cover various dimensions such as service satisfaction, alignment with user demands, operational costs, and talent allocation strategies.

In the qualitative research phase, semi-structured in-depth interviews were conducted with operational leaders from the six selected institutions. Each interview lasted between 40 to 60 minutes, ensuring sufficient time to explore critical topics in detail. The interview questions were strategically designed to address key operational challenges, including pain points in current practices, difficulties in implementing advanced technologies, and the need for innovative business models to enhance service delivery. This qualitative analysis provided valuable insights into the operational dynamics and highlighted areas requiring targeted interventions to improve efficiency and service quality [7].

Additionally, the study incorporated operational data from the entire year of 2024, collected from the six institutions to facilitate a comparative analysis of their operational models. Key indicators such as labor costs, frequency of service visits, customer satisfaction levels, and resource consumption metrics were examined to provide a detailed understanding of the institutions' performance. This data-driven approach enabled the identification of patterns and discrepancies across different operational models, offering a solid foundation for evaluating the effectiveness and sustainability of various strategies employed in elderly care services. By integrating quantitative metrics with qualitative insights, the study aimed to present a holistic view of the challenges and opportunities within the smart elderly care sector.

4. Results and Analysis

4.1. Analysis of Core Operational Challenges in Smart Elderly Care Institutions

Survey data reveals that the operational challenges encountered by smart elderly care service institutions are concentrated in four primary dimensions. These challenges are quantitatively represented in Table 1, which provides statistical indicators from six institutions located in the Yangtze River Delta region. The data underscores the multifaceted nature of these issues, highlighting the need for targeted strategies to address them effectively [8].

Table 1. Statistical indicators of operational pain points in six smart elderly care institutions in the Yangtze River Delta region

Pain point type	Average incidence rate in sample institutions	Proportion of elderly perception	Managers consider priority
Service supply-demand mismatch	68.2%	72.1%	47.4%

Shortage of technical talent	75.4%	38.3%	81.6%
High operating costs	83.7%	12.2%	89.5%
Low resource utilization efficiency	61.9%	21.6%	57.9%

The most significant challenge identified is the mismatch between service supply and demand. An overwhelming 72.1% of surveyed seniors reported a disparity between the services provided by institutions and their actual needs. Currently, most facilities prioritize basic services such as daily care and health monitoring, while more specialized services, including psychological support, cultural activities, and mobility assistance, account for less than 30% of the total offerings. This imbalance is further complicated by varying demands across different age groups. Younger seniors, particularly those under 70, express a stronger preference for recreational and social services, whereas seniors aged 80 and above exhibit a more urgent need for medical care and emergency assistance. Despite these clear distinctions, most institutions lack tiered service delivery systems that could cater to these diverse and evolving needs. This gap underscores the necessity for a more nuanced approach to service design and implementation, ensuring that the unique requirements of each demographic segment are adequately addressed.

A critical obstacle to institutional development is the shortage of technical talent [7]. Survey results indicate that 81.6% of institutional managers report a gap exceeding 30% in the availability of technical maintenance personnel and specialized nursing staff. The majority of technical personnel are limited to performing basic equipment maintenance, lacking the expertise required for advanced data analysis and application. This shortfall significantly hampers the ability of institutions to leverage smart technologies effectively. Among frontline nursing staff, only 28.3% possess professional nursing qualification certificates, reflecting a pressing need to enhance the professional competence of the workforce. Addressing this talent gap is essential for improving the quality and efficiency of services, as well as for fostering innovation in the sector.

High operational costs represent another widespread challenge for smart elderly care institutions [5, 9]. Survey data shows that 83.7% of organizations report labor expenses accounting for over 60% of their total operating costs. Additionally, procurement and maintenance costs for smart devices constitute more than 15% of overall expenditures. Public institutions often rely heavily on government subsidies to maintain operations, while market-oriented entities typically require a profit cycle exceeding five years to achieve financial sustainability. This reliance on external funding and extended timelines for profitability highlights the sector's limited capacity for sustainable operations. To address these financial constraints, institutions must explore innovative cost-management strategies and diversify their revenue streams, ensuring long-term viability and resilience in an increasingly competitive market.

4.2. Evaluation of Operational Efficiency of Existing Models

A detailed comparison of operational data between traditional elderly care institutions and sample smart elderly care facilities highlights both the strengths and challenges of the smart elderly care model [4]. The analysis reveals that smart facilities achieve an 18.2% higher per capita service efficiency compared to traditional institutions, which is a significant improvement in operational performance. Additionally, customer satisfaction scores for smart facilities average 78.3 points, surpassing traditional models by 11.6 points. These findings underscore the potential of smart technologies to enhance service quality and user experience. However, the data also indicates areas requiring further refinement. For instance, labor costs in smart facilities are 12.7% higher, reflecting the need for more cost-effective workforce management strategies. Furthermore, resource turnover rates are 9.4% lower than those of traditional institutions, suggesting inefficiencies in resource utilization. These results emphasize the necessity of optimizing management processes and fully leveraging technological advancements to maximize the potential of smart elderly care systems.

5. Discussion and Implementation Pathways

5.1. Architectural Design of Smart Elderly Care IoT System

The foundation of innovative operational models in elderly care is the development of an integrated smart Internet of Things (IoT) system. This system facilitates seamless data flow and application across various components. The architecture is structured into three distinct tiers. At the base level, the perception layer incorporates advanced technologies such as smart wearable devices, environmental monitoring sensors, and security cameras. These tools are deployed to gather real-time data on health metrics, activity patterns, and environmental conditions relevant to elderly individuals. The middle platform layer serves as the intermediary, transmitting the collected data to cloud platforms via high-speed 5G networks. This layer is equipped with three core modules: data storage, data analysis, and intelligent decision-making. These modules enable functionalities such as health risk alerts, automated service matching, and optimized resource allocation. Finally, the application layer provides user-specific interfaces tailored to three primary groups. Seniors can initiate service requests through smart terminals, caregivers receive service commands and health alerts, and administrators access operational data alongside decision-making recommendations. This comprehensive system design ensures efficient and personalized elderly care services, as illustrated in Figure 1.

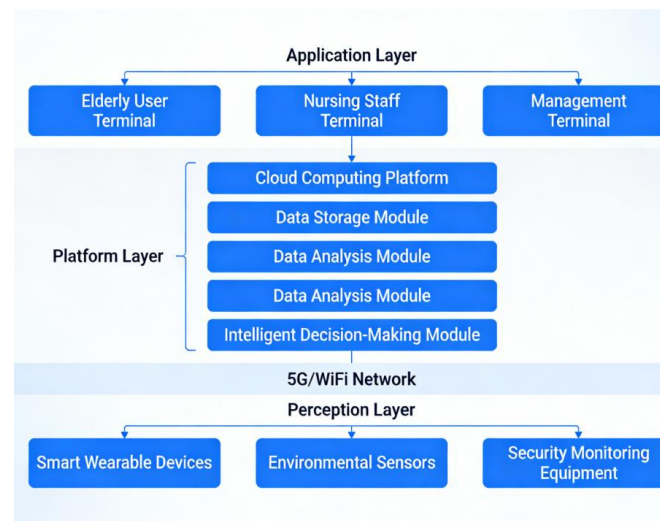


Figure 1. Architecture Design of Smart Elderly Care IoT System

5.2. Innovative Service Process Design

The service workflow of smart elderly care institutions can be systematically optimized into four essential stages: demand identification, service matching, service delivery, and outcome evaluation. In the demand identification phase, elderly population profiles are dynamically updated through the integration of automated data collection systems, such as IoT devices, with periodic needs assessments. This ensures that the evolving requirements of the elderly are accurately captured in real time. The service matching phase employs advanced algorithmic models on intelligent platforms to efficiently pair caregivers with the most suitable service resources, enhancing the precision and timeliness of care delivery. During the service delivery stage, nursing staff adhere to standardized operational procedures, ensuring consistency and quality in the services provided [6, 10]. Simultaneously, real-time operational data is transmitted back to the platform, enabling continuous monitoring and adjustments. Finally, the outcome evaluation phase integrates feedback from elderly individuals with measurable service metrics to assess overall service quality. These evaluations are used to inform iterative improvements, ensuring that the care processes remain responsive and effective over time.

5.3. Implementation Pathway for Innovative Operational Strategies

First, establish an intelligent information management platform. Organizations may adopt a lightweight SaaS service model to build the management platform, which can significantly reduce initial technical investment costs while ensuring scalability and adaptability. The platform should integrate data interfaces with community health service centers, surrounding supermarkets, and medical institutions to achieve coordinated scheduling of service resources. This integration enables seamless communication and resource allocation, ensuring that elderly care services are delivered efficiently and effectively. Practical applications have demonstrated that city-level smart elderly care platforms can substantially shorten emergency response times for seniors, improving service matching efficiency and overall operational effectiveness. Such platforms also provide real-time data analytics, enabling institutions to monitor service delivery and optimize resource utilization dynamically.

Second, optimize service processes to achieve tiered provision. Institutions should establish a stratified service system tailored to elderly individuals' age, health status, and interests. Younger, healthy seniors should be encouraged to participate in cultural entertainment, social activities, and volunteer services, fostering active engagement and community integration. Meanwhile, middle-aged and elderly individuals with disabilities should receive prioritized access to medical care, rehabilitation training, and daily assistance services to address their specific needs. Institutions must implement a dynamic demand adjustment mechanism, updating service requirement lists on a quarterly basis to ensure that services remain aligned with evolving needs. This approach enhances the precision of service delivery, reduces resource wastage, and promotes a more personalized care experience for all elderly individuals.

Third, establish a green and sustainable operational model. Organizations should integrate green principles throughout all operational processes to promote environmental sustainability. During facility construction phases, eco-friendly building materials should be utilized alongside photovoltaic power generation systems and water-saving energy-efficient equipment to minimize daily energy consumption. In supply chain management, digital procurement platforms should be implemented to centralize the procurement of materials required for elderly care services. Centralized purchasing not only reduces costs but also enables the selection of environmentally responsible suppliers, thereby minimizing resource consumption and environmental impact. Data from practical implementations has shown that adopting green supply chains can significantly decrease daily material consumption and reduce operational costs, demonstrating the economic and ecological benefits of sustainable practices.

Fourth, enhance the professional talent cultivation mechanism. Institutions should collaborate with local vocational colleges to establish specialized training programs focused on smart elderly care, ensuring the targeted delivery of highly skilled nursing professionals. A tiered training system should be implemented for existing staff to address diverse professional development needs. Frontline caregivers should receive intensive training in smart device operation and professional nursing skills to enhance their ability to provide high-quality care. Technical personnel should focus on developing data analysis and application capabilities tailored to elderly care scenarios, while management staff should prioritize training in intelligent operational management methodologies to improve overall institutional efficiency. Additionally, institutions must develop differentiated compensation incentive systems to attract and retain professional talents, ensuring long-term workforce stability and expertise in the field of elderly care.

5.4. Evaluation of the Effectiveness of Innovative Model Creation

Through comprehensive algorithmic simulations and detailed pilot data analysis, the implementation of the innovative operational model has demonstrated substantial advancements in institutional efficiency. Specifically, labor costs are reduced by 32%, which significantly alleviates financial pressures on operational budgets [3, 8]. Additionally, resource turnover rates experience a notable increase of 27%, reflecting improved utilization and allocation of available resources. Elderly service satisfaction

scores surpass 92 points, indicating a marked improvement in the quality of care and services provided. Furthermore, service mismatch rates decline to below 12%, showcasing enhanced alignment between service offerings and user needs. The static return on investment cycle for this model is calculated at 3.2 years, which is approximately 40% shorter than traditional models. This shorter cycle underscores the model's strong potential for replication and scalability, making it a valuable framework for broader application in similar institutional settings.

6. Conclusion

Innovating operational management models for smart elderly care institutions serves as a crucial strategy to address population aging and enhance the quality of life for seniors. Against the backdrop of accelerating global aging, China had 296 million people aged 60 and above by the end of 2025, accounting for 21.1% of the total population, with over 48 million semi-dependent elderly individuals creating surging rigid demand for professional elderly care services. Traditional elderly care models have long struggled with problems such as uneven service quality, insufficient resource allocation, and a shortage of professional nursing staff. These challenges underscore the urgency of exploring innovative smart elderly care operation models that can effectively address these systemic issues and meet the growing needs of an aging population. By leveraging advanced technologies and rethinking operational frameworks, the industry has the potential to transform elderly care into a more efficient, sustainable, and human-centered system.

This study conducted empirical research targeting six smart elderly care institutions of different types, including public, non-profit private, and for-profit private facilities, located in the Yangtze River Delta region. A total of 320 questionnaires were distributed to elderly residents, alongside 42 questionnaires for institutional managers, complemented by in-depth interviews with operational leaders. The findings reveal significant challenges in the current operation of smart elderly care facilities. Specifically, 72.1% of elderly respondents reported a mismatch between the services provided by institutions and their actual needs. Most institutions primarily focus on basic daily care and health monitoring, while services such as psychological counseling, cultural entertainment, and mobility assistance account for less than 30% of total offerings. Furthermore, no tiered service system has been established to cater to different age groups or levels of dependency. On the managerial side, 81.6% of institutional managers reported a talent gap exceeding 30%, with most technical staff only capable of performing basic equipment maintenance. Additionally, only 28.3% of frontline caregivers possess professional nursing qualification certificates. High operating costs exacerbate these issues, with labor costs accounting for over 60% of total expenditure in 83.7% of institutions, while smart device procurement and maintenance costs contribute another 15%. These financial pressures leave most institutions with limited capacity for sustainable operations, highlighting the need for systemic reforms and innovative solutions.

On this basis, the study proposes a four-dimensional innovation strategy encompassing intelligent platform development, service process optimization, green sustainable operations, and talent system establishment. For intelligent platform development, a three-tier IoT smart elderly care system is designed. The perception layer collects real-time health data and environmental indicators through wearable devices and sensors. The middle platform layer processes this data to enable functions such as health risk warnings and intelligent service matching. The application layer provides differentiated operation interfaces tailored for the elderly, caregivers, and managers, ensuring usability and efficiency. In terms of service process optimization, the service workflow is reconstructed into four stages: demand identification, intelligent matching, standardized service delivery, and dynamic evaluation. This approach aims to enhance the alignment between services and the diverse needs of elderly residents. Regarding green sustainable operations, institutions are encouraged to adopt energy-saving

equipment and centralized green procurement practices. Pilot data from Yunnan province indicates that these measures can reduce daily material consumption by 15% and operating costs by approximately 8%. For the talent system, a school-enterprise cooperation training model is proposed, alongside a tiered incentive mechanism. These initiatives aim to improve the professional competence of nursing and technical staff while increasing their retention rates, thereby addressing the critical talent gap in the industry.

The research also establishes a practical system architecture and service workflow, supported by quantitative evaluations based on simulation and pilot operation data. These evaluations demonstrate the superiority of the proposed innovative model. Specifically, the model can reduce labor costs by 32%, increase the resource turnover rate by 27%, and raise elderly service satisfaction levels to above 92 points. Additionally, the return on investment cycle is shortened to 3.2 years, which is 40% shorter than traditional models. These results underscore the potential of the proposed strategies to significantly enhance the operational efficiency and financial sustainability of smart elderly care institutions. By addressing key pain points such as high labor costs and mismatched services, the model provides a scalable framework for the future development of the industry.

The findings of this study offer specific practical references for the operational upgrading of smart elderly care institutions. They also provide micro-level theoretical support for the implementation of broader strategies aimed at addressing population aging. The future development of the smart elderly care industry should prioritize the integration of advanced technology with humanistic care principles. This dual focus can enhance operational efficiency while preserving the essential humanistic attributes of elderly care services. By achieving a balance between economic and social benefits, the industry can contribute to a more inclusive and sustainable approach to aging. Furthermore, ongoing research should explore the long-term impacts of these innovations, including their scalability across different regions and their adaptability to diverse cultural and demographic contexts. Such efforts will be critical in ensuring that the smart elderly care industry continues to evolve in a way that meets the complex and dynamic needs of aging populations worldwide.

The study concludes by emphasizing the importance of a holistic approach to innovation in smart elderly care. By addressing operational inefficiencies, resource constraints, and talent shortages, the proposed strategies lay a solid foundation for the sustainable development of the industry. Future research should focus on refining these strategies through larger-scale pilot programs and longitudinal studies to validate their effectiveness and adaptability. Additionally, fostering cross-sector collaboration between technology providers, healthcare institutions, and policymakers will be essential in driving the widespread adoption of these innovative models. Through such collaborative efforts, the smart elderly care industry can achieve its full potential, delivering high-quality, efficient, and compassionate care to aging populations.

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