

# ***Transforming “Aging into Enjoying Aging”-- Designing Pathways for Smart Community Eldercare***

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**Abstract.** This paper explores the development path design for the intelligent transformation of community-based public facilities for elderly care, aiming to address the challenges of “passive aging” and promote the vision of “enjoyable aging”. The research is grounded in China’s aging population trend, the challenges faced by domestic community elderly care, and the transformative potential of smart technologies. Through literature review and case analysis, this study examines the core definition, classification, and domestic status of smart community elderly care facilities. It identifies key pathways for intelligent transformation, including demand-side adaptation, collaborative supply mechanisms, and quality enhancement through whole process supervision. The findings suggest that smart elderly care communities, by integrating technological empowerment with humanistic concern, can significantly improve health management efficiency, reduce the occurrence of accidents, and help preserve the autonomy of the elderly. However, challenges remain, such as insufficient age-friendly technology design, fragmented service coordination, lack of standardized systems, and limited public health data sharing. This study provides insights and references for the construction of smart elderly care communities, offering a technical foundation for the shift from experience-driven to data-driven services and achieving precision governance in elderly care.

**Keywords:** smart elderly care, public facilities, community public services, age-friendly design

## **1. Introduction**

### **1.1. Research background**

China’s development of community-based elderly care facilities stems from “aging before affluence” and “urban-rural population dynamics”. By 2025, the population aged over 60 is projected to exceed 300 million, reaching 21.1% of the national total [1]. As family structures continue to hollow out, traditional home-based care faces mounting pressure, while institutional care remains inaccessible for many due to high costs and emotional disconnect.

Amid these changes, technological breakthroughs in IoT, big data, and AI are transforming community-based elderly care. These innovations facilitate proactive health interventions through continuous data collection, extend service reach via smart devices, and optimize resource allocation

algorithmically. Pioneering cases, like Japan's rapid fall detection and Shanghai's wearable-based chronic disease management [2], illustrate a paradigm shift from passive response to active prevention. This transformation goes beyond improving service efficiency. It lays the groundwork for predictive analytics and personalized care, which are essential for aging societies.

Building on this foundation, the following section explores how integrated IoT platforms, AI-driven predictive algorithms, and centralized data ecosystems operationalize the proactive care paradigm through three thematic dimensions: technological innovation, policy implications, and user experience. Empirical evidence validates these enablers while revealing persistent challenges related to equitable access and long-term sustainability.

## **1.2. Technological integration and service innovation in smart elderly care communities**

### **1.2.1. Technological innovation: infrastructure and data integration**

Technological innovation in smart elderly care centers on three interconnected domains: real-time health monitoring through IoT ecosystems, predictive analytics for risk intervention, and centralized data integration for personalized care. Empirical evidence demonstrates their transformative potential: IoT Ecosystems enable continuous physiological tracking. For instance, Xu et al. integrated wearable biosensors, environmental detectors, and activity trackers into unified health platforms [2]. Predictive Analytics leverages AI algorithms to anticipate health crises. Lu & Lin demonstrated that radar-based gait analysis reduced fall emergency latency by 37% through 5-second alerts [3]. Centralized Data Platforms synthesize multi-source inputs (e.g., wearables, EHRs), as seen in Shanghai's cloud systems, which improved hypertensive medication adherence by 28% through personalized health profiles [4]. Moreover, emerging tools such as blockchain-enabled resource sharing (e.g., Man Xiaoou's trust-based model [5]) and AI-driven health interfaces (e.g., Ding Qun's adaptive tools [6]) further enhance service precision. Despite these advances, the full realization of technological capabilities critically depends on supportive policy frameworks and institutional collaboration. These challenges will be explored in the following section.

### **1.2.2. User experience: adoption and service quality**

User-centric efficacy in smart elderly care hinges on resolving accessibility barriers, understanding satisfaction drivers, and implementing dynamic evaluation systems. Key findings reveal:

- Accessibility barriers arise from persistent mismatches between technological complexity and elderly digital literacy exacerbate exclusion risks across diverse socioeconomic contexts [6,7].
- Satisfaction drivers such as perceived service quality (e.g., alert reliability) and value gains (e.g., autonomy enhancement) directly predict adoption rates, while ease-of-use effects are mediated through these factors [8].
- Performance metrics are best captured through multidimensional frameworks. Zhao Hengbo's model assesses facilities, personnel, service content, and outcomes through adaptive improvement cycles [9].

### **1.2.3. Policy implications: governance and systemic barriers**

The effective implementation of smart elderly care requires addressing three policy imperatives: collaborative governance frameworks, market-institutional synergies, and systemic capacity building. First, collaborative governance requires multi-stakeholder partnerships to bridge equity gaps. Renshanshan et al.'s case in Shenyang illustrates how a coalition among government

agencies, NGOs and tech enterprises helped reduce digital exclusion among elderly populations [7]. Secondly, market-government synergy is vital. Liu Sujun shows that PPP models and fiscal incentives can catalyze sustainable “new quality productivity” [10]. Third, systemic challenges such as fragmented operational mechanisms and underspecified regional adaptations continue to hinder large-scale scalability [11]. These institutional and governance issues ultimately affect outcomes at the user level, where technology adoption and service quality perceptions determine real-world impact. A dynamic is further examined in the next section on user experience.

Collectively, these findings establish a tripartite foundation for sustainable smart elderly care:

- Technological enablers (Section 1.2.1: IoT, predictive AI, data integration) create the infrastructure for proactive intervention.
- Policy-institutional frameworks (Section 1.2.2: collaborative governance, market synergies) provide implementation pathways.
- User-centered validation (Section 1.2.3: accessibility, satisfaction, metrics) ensures real-world applicability.

To close persistent gaps, especially culturally adaptive design and operational sustainability, it is essential to contextualize frameworks, like Guo Qihan’s EDSP model [11]. These models support the transition from fragmented pilot programs to scalable, inclusive ecosystems for smart elderly care.

### 1.3. Research objectives and significance

Currently, community-based elderly care services are largely reactive, focusing on post-incident remediation, such as emergency alerts after falls or medical interventions following illness onset [8]. This study aims to explore the transformative potential of intelligent technologies in shifting the paradigm from passive to proactive care.

This paper investigates smart public facilities with elderly care communities, identifying fundamental strategies and guiding principles for their development. It integrates inclusive design concepts with digital technologies in facility implementation. Furthermore, the study proposes future research directions to strengthen both theoretical frameworks and practical designs for inclusive smart elderly care communities.

## 2. Research content

### 2.1. Definition and classification of smart community elderly care facilities

Intelligent public facilities for the elderly in the community aim to create a community conducive to education, learning and healthy living for the elderly group. These facilities are designed with a comprehensive understanding of the diverse needs and daily behavior patterns of the elderly group and provide convenient public facilities for the elderly.

Based on their technical functions and service scenarios, these facilities can be categorized into four types, as shown in Table 1.

Table 1. Classification of smart community elderly care facilities

Type	Core Technologies	Value Propositions
Health Management Facilities	IoT + AI, Biosensors, Wearables	Chronic disease prevention & dynamic monitoring: Real-time vital sign collection (e.g., BP/SpO <sub>2</sub> ); closed-loop personalized health intervention (Monitor → Analyze → Intervene) [3]
Safety Monitoring Facilities	Radar-based tracking, Smart environmental sensors	Accident risk reduction: Individual behavior monitoring (e.g., fall detection); environmental hazard alerts (e.g., gas leaks)
Daily Life Support Facilities	LiDAR + Obstacle-avoidance algorithms, Human-machine collaboration	Life scenario reconstruction & autonomy enhancement: Autonomous navigation of smart walkers (indoor/outdoor); caregiver burden reduction while preserving dignity and decision-making [5]
Social Engagement Facilities	VR platforms, Visualized data interfaces	Social isolation mitigation: Virtual senior colleges (e.g., real-time collaborative art); community hubs (e.g., self-service libraries, data-driven group exercise); active aging facilitation [2]

## 2.2. Analysis of the current status of smart community elderly care facilities in China

### 2.2.1. Pilot outcomes (taking Beijing Taikang Yanyuan as an example)

#### 1. Case Context & Innovation Framework

Beijing Taikang Yanyuan pioneers intelligent elderly care in China, serving residents with an average age of 78, of whom 33% experiencing functional decline. Its whole-cycle care model integrates health management, safety protection, and life support through a fusion of humanistic and intelligent technologies.

#### 2. Technological Interventions & Analytics

- **Health Monitoring:** Non-invasive devices enable real-time physiological tracking, while AI-driven sleep monitoring triggers graded alerts, reducing emergency response time. Automated medication systems reduce errors [8].

- **Safety & Life Support:** Environmental sensors detect falls and adaptive special designs enhance QoL for residents with chronic conditions. AI customizes services via habit analysis while psychosocial devices foster emotional engagement to reduce loneliness [4].

- **Analytical Focus:** Comparative efficacy metrics vs. traditional institutions [4].

#### 3. Demonstrated Outcomes and Theoretical Implications

Quantitatively, chronic disease control outperforms traditional institutions, accident rates fall below industry averages, and night emergency response meets clinical standards. Operationally, reduced human dependency maintains service warmth through strategic automation, achieving sustainable cost-service equilibrium.

The core paradigm shift lies in humanistic-technological synergy: precision services (e.g., AI-customized support) free caregivers to focus on empathetic engagement, transforming technology into a “compassion amplifier” that reinforces elderly dignity [11]. This positions Taikang Yanyuan as a replicable blueprint for reconciling technological efficiency with humanistic care in aging societies.

## 2.2.2. Key systemic constraints

Based on the research results of Taikang Yanyuan and supporting literature, the main constraints facing smart community eldercare are summarized in Table 2.

Table 2. Main constraints for smart community eldercare

Constraints	Key Manifestations	Consequences	Source
Technology Accessibility Gap for Elderly Users	<ul style="list-style-type: none"> <li>• Device interfaces are designed with younger users in mind</li> <li>• Technological design misaligned with seniors' cognitive patterns</li> <li>• Applications overlook natural aging processes (e.g., physical and cognitive decline)</li> </ul>	<ul style="list-style-type: none"> <li>• Creates usage barriers for the elderly</li> <li>• Widens the digital divide and marginalizes seniors</li> <li>• Passive reception breeds distrust and generates resistance (“unwillingness to use”)</li> </ul>	[8]
Fragmented Service Supply and Coordination	<ul style="list-style-type: none"> <li>• Platforms lack effective resource allocation mechanisms and suffer from weak technical coordination</li> <li>• Complex stakeholder environment (community, government, hospitals, institutions)</li> <li>• Implementation pressure falls on communities</li> </ul>	<ul style="list-style-type: none"> <li>• Hinders intelligent decision-making</li> <li>• Leads to inefficient service allocation</li> <li>• Increases operational burden on the community workload</li> </ul>	[7]
Siloed Public Health-Medical Data Resources	<ul style="list-style-type: none"> <li>• Cross-system information barriers block data sharing</li> <li>• Lack of a unified national health database</li> <li>• Unintegrated regional smart elderly care platforms</li> </ul>	<ul style="list-style-type: none"> <li>• Fragmented health interventions</li> <li>• Creates information islands</li> <li>• Hinders comprehensive care coordination</li> </ul>	[5]

## 2.3. Strategic pathways for systemic transformation

### 2.3.1. Demand-side adaptation: closing the technology accessibility gap

Some health monitoring devices only regard the elderly as a collection of physiological indicators, neglecting their rich characteristics as independent individuals. This limited technology inadvertently widens the gap between the elderly and the digital age, resulting in an insurmountable “digital divide” [9]. To address these issues, the key lies in shifting technology from simply pursuing “technological affordance” to focusing on life accessibility”, meaning technology must align with the actual living needs and life experiences of the elderly.

Intergenerational justice concepts should be incorporated into the design of technological products, fully considering the special needs of the elderly. A certain degree of faulty tolerance should be built into product design, giving the elderly enough time to adapt to and learn new technologies [2]. Moreover, a coordination and adaptation mechanism for the “technology-body-environment” should also be established. With the help of environmental intelligence technology, the elderly can enjoy services without complex touch operations, enabling technology to better integrate into their daily lives and achieve “seamless” services.

Establishing an institutionalized channel for the elderly to participate in the technological governance process is of great significance to them, enabling them to transform from passive recipients of technology to co-designers [3]. As technology continues to evolve, the organic integration of the elderly's traditional living habits and the logic of technological innovation can be achieved, creating technological products and services that are better aligned with the living conditions and preferences of the elderly.

### 2.3.2. Collaborative supply integration: resolving fragmentation

Collaborative supply mechanisms are essential to resolve fragmentation in smart elderly care. A tripartite strategy is proposed:

First, a unified resource platform should be established to integrate multi-stakeholder data, spanning communities, governments, hospitals and institutions. This enables dynamic resource allocation and real-time visibility of supply and demand, significantly improving utilization efficiency [3].

Second, clarified roles enhance inter-departmental coordination: (1) The government leads through policymaking, funding, and oversight [6]; (2) Communities organize and deliver services; (3) Medical and care institutions provide specialized support. Joint conferences institutionalize problem-solving.

Third, market mechanisms invigorate supply via government service-purchasing and PPP models, improving both service quality and efficiency [10].

### 2.3.3. Data governance and quality control: unlocking siloed resources

Strengthening national data infrastructure is vital to unlocking siloed resources. This involves building a systematic national information database and integrating intelligent elderly care platforms across regions. The goal is full data interconnection and sharing, supported by a unified information management and supervision platform. Comprehensive supervision must cover the intelligent construction of community elderly care facilities and service implementation. Through data analysis methods, various problems in the service process can be promptly detected and resolved, thereby enhancing the scientific basis and precision of decision-making [11]. For example, an information platform can be used to conduct real-time monitoring and evaluation of the service quality, staffing status, and facility operation of elderly care service institutions. Institutions that fail to meet the standards should be urged to make rectifications.

## 3. Research results and conclusions

This study comprehensively demonstrates the necessity, feasibility, and implementation pathways for the intelligent transformation of public facilities in community-based elderly care. The findings indicate that intelligent technologies, by reconstructing service logic, shifting from passive response to proactive prevention, expanding service boundaries from physical space to digital space, and optimizing resource allocation through a transition from empirical judgment to data-driven decision-making, can effectively address the care pressures and intergenerational conflicts faced by aging societies. However, technological empowerment must adhere to an elderly-centric value orientation, avoiding the pitfall of “prioritizing intelligence for intelligence’s sake”.

Future development of intelligent elderly care should focus on three directions: (1) Promoting the standardization of age-friendly technologies to bridge the “digital divide”; (2) Establishing a collaborative supply network involving government, market, and community stakeholders to overcome resource fragmentation; (3) Enhancing data security and privacy protection mechanisms to ensure ethical and compliant technology applications. Only by deeply integrating technological innovation with humanistic care can we truly realize the societal vision of “providing for and ensuring the well-being of the elderly”. In doing so, China can contribute meaningful solutions to the global governance of aging.

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