

Investigation and Analysis of the Age-Friendly Dilemma of Smart Elderly Care Services under AI Empowerment

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Abstract

Against the backdrop of population aging and the widespread adoption of digital technologies, artificial intelligence (AI) is increasingly being integrated into home- and community-based eldercare. However, many older adults continue to face a digital divide, while smart eldercare products often provide only superficial age-friendly adaptations and fail to match users' needs. This study examines older residents of urban communities and their family members. Drawing on a literature review, a questionnaire survey, and semi-structured interviews, it investigates the development of AI-enabled smart eldercare services and the difficulties older adults encounter when using smart devices and related services. Informed by digital divide theory, active aging theory, and supply-and-demand matching theory, the study analyzes the factors underlying these difficulties and proposes a smart eldercare service model that uses age-friendly short videos as a delivery medium and intergenerational collaboration as its core mechanism. It further develops operational strategies across six dimensions: content, target groups, channels, technology, implementation, and operations. Survey findings are used to assess the model's feasibility. The proposed approach offers communities and social organizations a low-cost, practical framework for more inclusive smart eldercare services, with the aim of narrowing the digital divide and supporting active aging.

Keywords: Smart Eldercare; Artificial Intelligence; Age-Friendly Design; Digital Divide; Intergenerational Collaboration

1. Introduction

Population aging is a long-term demographic trend in China, and home- and community-based care are currently the predominant forms of eldercare. Advances in artificial intelligence (AI) and other intelligent technologies have accelerated the development of smart eldercare and expanded the range of digital services. At the same time, the digital divide affecting older adults has become increasingly visible. Although many older adults are willing to use digital products, existing designs

often fail to accommodate their needs and abilities. Age-related physiological changes, insufficient ongoing guidance, and concerns about information security can prevent them from benefiting from digital eldercare services. Existing research has focused largely on hardware development and macro-level policies, with less attention to basic, inclusive, and lightweight online services. This study therefore explores a cost-effective, user-friendly, and sustainable model for age-friendly smart eldercare based on short-video media and intergenerational collaboration.

This study focuses on older residents of urban communities. A review of the literature is used to synthesize research on smart eldercare, age-friendly adaptation, and the digital divide. Primary data are collected through questionnaires and semi-structured interviews to identify older adults' needs in daily care, emotional support, and digital learning, and to examine barriers to age-friendly AI-enabled eldercare. On this basis, the study develops a service model that combines short-video resources with intergenerational collaboration, proposes operational strategies across multiple dimensions, and assesses their feasibility. It concludes by summarizing the findings, discussing limitations, and outlining directions for future research. The study contributes to research on inclusive smart eldercare and efforts to bridge the digital divide. In practice, it offers communities and social organizations a low-cost, actionable framework for age-friendly digital eldercare services, with the aim of helping older adults participate more fully in the digital society and supporting active aging.

2. Theoretical Framework

2.1. Digital Divide Theory

Digital divide theory encompasses not only disparities in access to hardware but also differences in digital skills and user experience. Older adults are particularly affected by these disparities (Pan & Qiu, 2021). Physiological and cognitive changes, together with a lack of systematic learning resources, can make it difficult for older adults to benefit from smart eldercare services. Reports by the U.S. National Telecommunications and Information Administration (NTIA) have also documented disparities in digital access and skills. This perspective provides a theoretical basis for examining the difficulties older adults encounter when using smart eldercare services.

2.2. Active Aging Theory

Active aging is commonly understood in terms of three dimensions: health, participation, and security (World Health Organization, 2002; Xiong, 2025). Beyond material security, this perspective emphasizes older adults' social participation and well-being, including their opportunities to participate in digital society. Accordingly, AI-enabled smart eldercare should address not only hardware and functional needs but also emotional companionship, digital learning, and opportunities for self-development. The World Health Organization's policy framework highlights social participation and personal development, aligning with this study's focus on intergenerational collaboration, emotional support, and digital inclusion.

2.3. Supply and Demand Matching Theory

Supply-and-demand matching theory emphasizes aligning service provision with actual user needs. Drawing on Walras's theory of general equilibrium, it focuses on the dynamic balance between supply and demand (Walras, n.d.). At present, AI-enabled smart eldercare products and services may fail to address the needs of older adults living alone, creating a mismatch between supply and demand. This study applies this perspective to smart eldercare to examine the causes of age-friendly adaptation challenges and to inform the optimization of eldercare service models.

3. Research Design: Smart Eldercare and Age-Friendly Adaptation

AI technologies are increasingly being integrated into community-based eldercare. Smart devices and digital services are becoming more widespread, expanding the ways in which care services are delivered. However, many smart products are designed primarily for younger users and are updated rapidly, while their operation can be complicated.

Many older adults have limited digital skills and adopt new technologies at a slower pace. Existing age-friendly adaptations are often superficial and do not adequately address their actual needs. A theoretical discussion alone cannot capture the practical challenges of implementing smart eldercare. Accordingly, this study combines quantitative questionnaire data with qualitative interview data to examine how older adults in urban communities use AI-enabled smart eldercare services. The findings provide an empirical basis for identifying challenges and developing strategies. This chapter describes the survey population, research objectives, instruments, and implementation process.

3.1. Definition of the Research Population

The survey targeted permanent residents aged 60 years and older in urban communities. Eligible participants had lived in the community for an extended period, were in sufficiently stable physical condition, and could communicate independently. Individuals who were temporary residents or visitors, had severe cognitive impairments, or were unable to communicate were excluded to help ensure the validity of the sample. The survey used stratified sampling across four dimensions: age, living arrangements, educational attainment, and digital proficiency. It therefore covered older adults with a range of characteristics. The specific strata and selection criteria are presented in Table 1.

Table 1. Respondent stratification dimensions and grouping criteria

Stratification dimension	Specific category	Selection rationale
Age	60–69 years	Physical functioning, learning speed, and acceptance of digital technologies can vary substantially across age groups. Stratification helps capture these differences.
	70–79 years	
	80 years and older	

Living arrangements	Living alone	Living arrangements affect the availability of family support for digital tasks and day-to-day guidance.
	Living with a spouse	
	Living with children	
Educational attainment	No formal schooling	Educational attainment can influence reading comprehension, cognitive demands, and the capacity for independent learning.
	Primary school	
	Junior high school	
	Senior high school or above	
Digital proficiency	Digital-operation proficiency	Proficiency in using smart devices helps identify differences in the age-related barriers experienced by different groups.
	Beginner	
	Basic-function user	
	Proficient user	

3.2. Research Design

This study adopted a mixed-methods approach combining questionnaire surveys and semi-structured interviews.

3.2.1. Questionnaire Design

The questionnaire was designed to examine AI-enabled, intergenerationally supported smart eldercare. It targeted urban community residents aged 60 years and older and their family members and was distributed online and offline. It covered three practical areas: home safety, emotional loneliness, and the digital divide associated with limited age-friendly resources. Participants were grouped by age (60–69, 70–79, and 80 years and older), living arrangement (living alone, with a spouse, or with children), educational attainment (no formal schooling, primary school, junior high school, or senior high school and above), and digital proficiency (beginner, basic-function user, or proficient user). The survey included older adults who had lived in the community for an extended period, were in stable physical condition, and could communicate normally. It excluded temporary residents or visitors, those with severe cognitive impairments, and those unable to communicate. The questionnaire collected data on the use of and preferences for smart eldercare services, perceived gaps between service supply and demand, digital-learning characteristics, operational difficulties, and psychological concerns. These data provide quantitative support for the subsequent analysis and service-model development.

3.2.2. Interview Guide Design

Because questionnaires provide primarily quantitative data, they may not capture the depth of older users' experiences. Semi-structured interviews were therefore conducted as a complementary

qualitative method. Interviewees were selected at random from among the questionnaire respondents to represent different age groups, educational backgrounds, living arrangements, and levels of digital proficiency. The interview guide covered three areas: experiences with and preferences for smart eldercare devices; difficulties, resistance, and barriers encountered when learning to use smart devices; and suggestions for improving products, community-based eldercare support, and digital assistance. Questions were adapted flexibly to each respondent's pace of communication, and responses were recorded objectively to preserve the authenticity of the data. Table 2 summarizes the overall framework and core elements of the survey design.

Table 2. Summary of the core elements of the research design

Research module	Specific design content	Research function
Research population	Permanent residents aged 60 years and older in urban communities	Ensure comprehensive sample coverage and a reasonable sample structure that reflects the characteristics of older adults in urban communities.
Research objectives	Examine current use of smart eldercare services, summarize older adults' usage patterns, identify barriers to age-friendly adaptation, and collect relevant empirical data.	Define the main research focus and provide an empirical basis for analyzing the issues and developing recommendations.
Research methods	Questionnaire survey (quantitative) and semi-structured interviews (qualitative)	Balance the breadth of the survey data with the depth of interview findings and address the limitations of relying on a single method.
Questionnaire structure	Basic information	Use a staged structure to cover current usage, barriers, and user needs.
	Current use of smart eldercare services	
	Barriers to use	
	Suggestions for improvement	
Interview topics	User experiences	Explore subjective difficulties and underlying issues that questionnaires alone may not reveal, thereby enriching the findings.
	Reasons for operational difficulties	
	Suggestions for service improvement	
Implementation process	Preparation → Field visits → Data organization and analysis	Standardize the research process and ensure that the data are accurate, valid, and complete, thereby strengthening the rigor of the study.

4. Survey Findings on Age-Friendly Adaptation in Smart Eldercare

4.1 Analysis of Survey Findings

Regarding home safety, many respondents reported limited ability to respond to emergencies at home and expressed concern about falls, sudden illness, and accidents in which no assistance is available (Wu & Li, 2024). They therefore showed strong demand for one-touch emergency calls, alerts to abnormal conditions at home, and remote safety monitoring. Responses to the home-safety questions varied across risk categories. Falls were the most frequently reported concern (40%, 800 respondents), followed by sudden illness (30%, 600 respondents). A further 20% (400 respondents) were concerned about being unable to obtain help after an accident, while 10% (200 respondents) reported limited emergency-response and self-rescue capabilities (Figure 1). These findings suggest that falls and sudden illness are the two principal home-safety concerns. However, many smart eldercare products currently available on the market do not provide adequate age-friendly design, making independent use difficult for older adults.

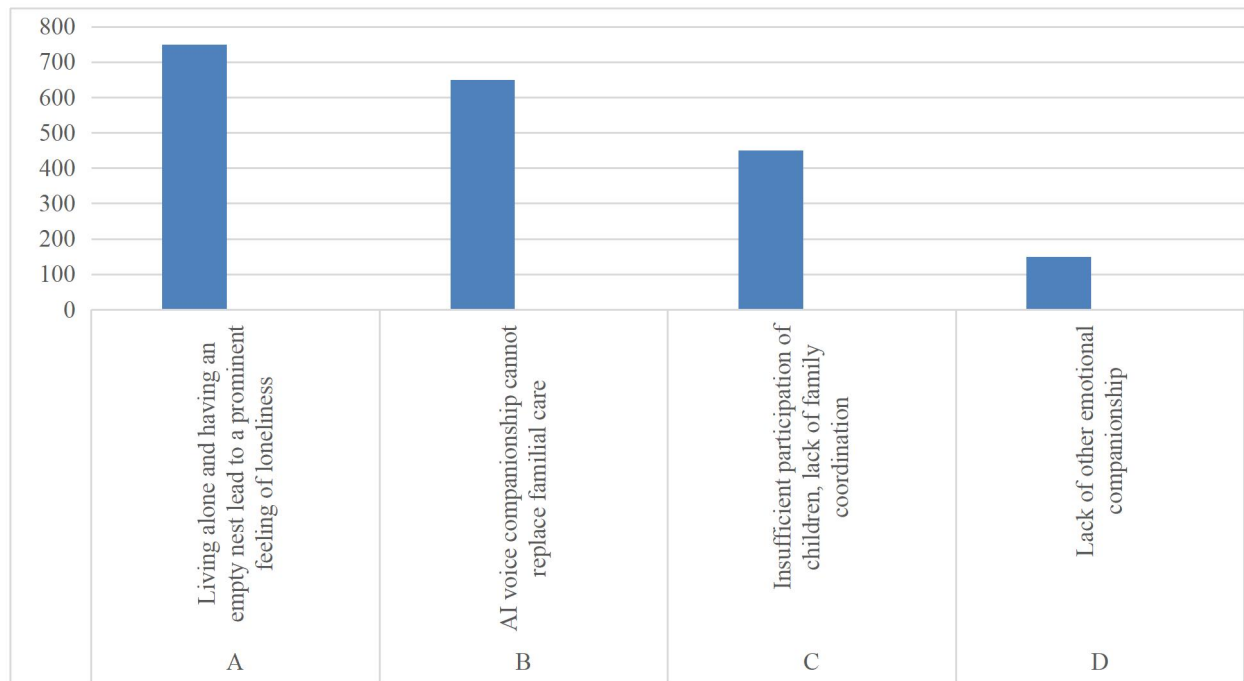


Figure 1. Home safety

With respect to emotional support and companionship, loneliness was a prominent concern among older adults living alone or in empty-nest households. Respondents indicated that AI-based voice interaction alone could not replace care from family members and expressed a preference for intergenerational companionship involving children and greater family coordination (Shen & Guan, 2025). Specifically, 37.50% (750 respondents) identified loneliness associated with living alone or in an empty-nest household as their primary emotional concern. Another 32.50% (650 respondents) said that AI voice companionship could not replace care from family members and questioned the emotional value of such systems. In addition, 22.50% (450 respondents) reported insufficient involvement from their children and a lack of family coordination, while 7.50% (150 respondents) reported other forms of unmet companionship needs (figure 2). These findings suggest that a lack of family companionship is a major source of emotional distress among older adults in empty-nest

households and that AI technology alone cannot compensate for the absence of genuine family affection.

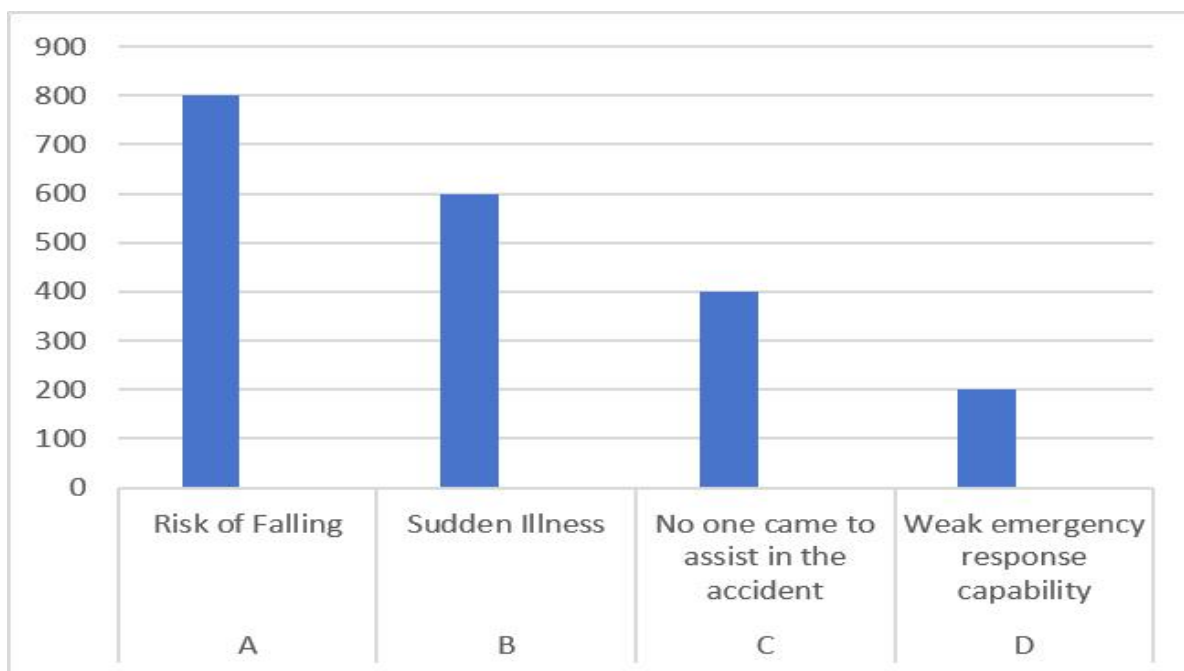


Figure 2. Emotional companionship

Regarding the digital divide, most older adults expressed a willingness to learn how to use smart eldercare devices. However, age-friendly learning resources were scarce, learning channels were limited, and instructional content was often difficult to understand. These barriers could create anxiety, reflected in the sentiment that people 'want to learn but do not know how, and want to use the technology but are afraid to try' (Pan & Qiu, 2021). Specifically, 35.00% (700 respondents) cited a shortage of age-friendly instructional resources and limited access to digital-learning opportunities; 27.50% (550 respondents) reported limited learning channels and a lack of systematic instruction; 22.50% (450 respondents) found the instructional content difficult to understand or insufficiently adapted to older learners; and 15.00% (300 respondents) felt intimidated, wanting to learn but not knowing how or wanting to use the technology but being afraid to try (figure 3). The scarcity of learning resources and limited access to instruction appear to be the main barriers to narrowing the digital divide.

Respondents generally showed a high level of acceptance of eldercare models that incorporate short-video instruction and support through multiple channels. Nevertheless, they raised concerns about ease of use, functional complexity, and technical reliability, all of which may undermine trust in AI-enabled eldercare services (Tang, 2025; Zheng, 2023). The distribution of concerns about AI-enabled smart eldercare products was similar to that of concerns about the digital divide. Specifically, 35.00% (700 respondents) considered these products difficult to operate and associated with a high learning threshold; 27.50% (550 respondents) found their functions too complex to master; 22.50% (450 respondents) were concerned about technical reliability and possible malfunctions; and 15.00% (300 respondents) expressed insufficient trust in AI-enabled eldercare services (Figure 4). Operational difficulty and functional complexity were the most frequently reported barriers to adoption.

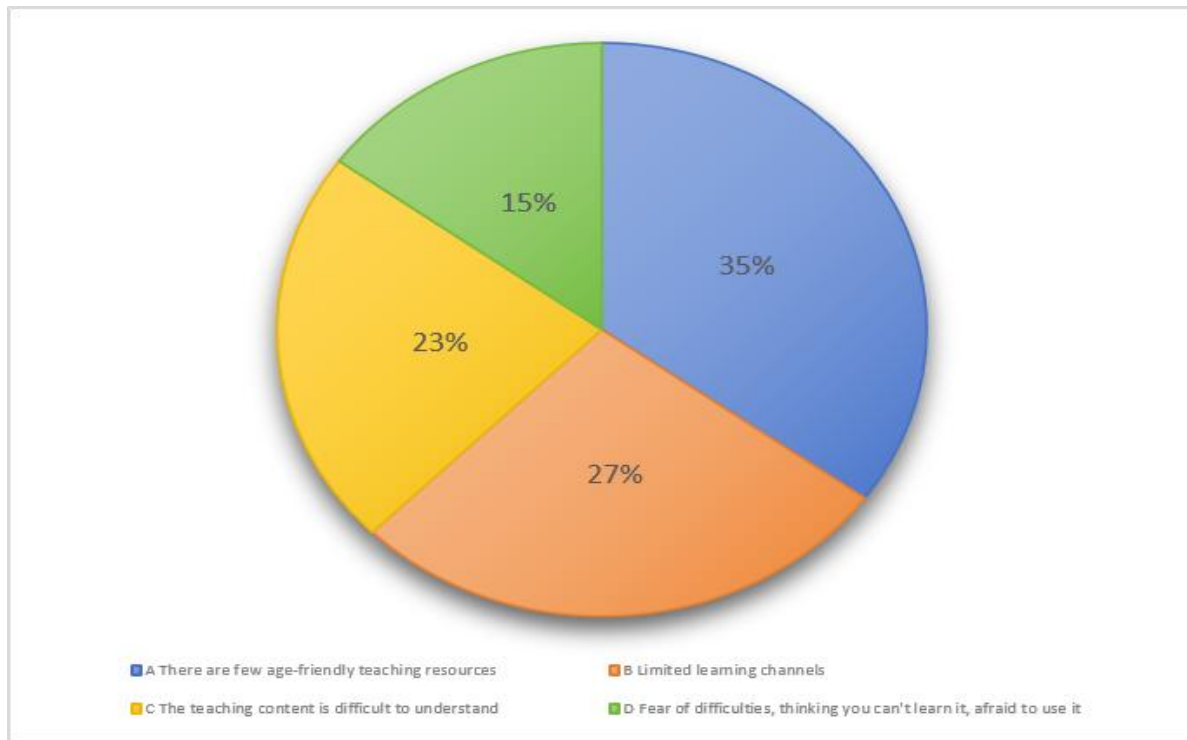


Figure 3. Digital divide

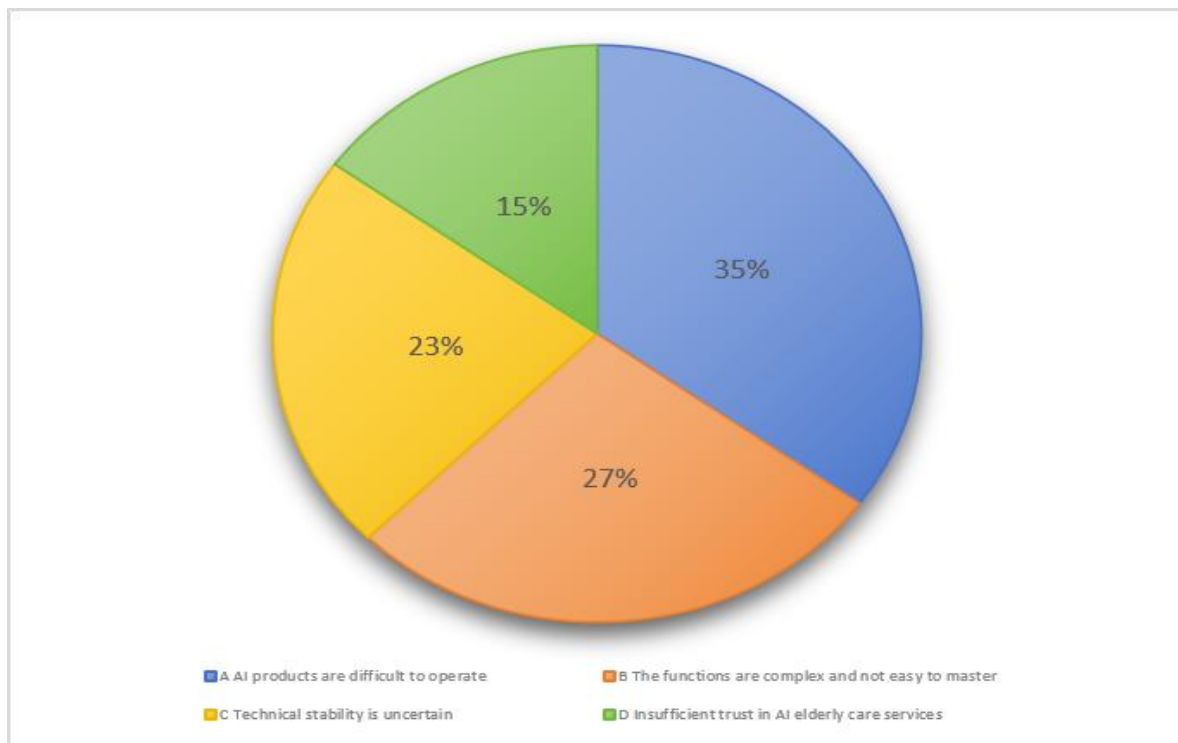


Figure 4. AI eldercare use and trust

4.2. Summary of Survey Findings

The survey findings can be summarized in four points. First, home-based eldercare involves several safety risks, and older adults have a strong need for emergency assistance, yet existing AI-enabled smart eldercare products are not sufficiently adapted to their needs. Second, AI-based companionship has limitations and cannot replace companionship from family members, leaving

some emotional needs unmet. Third, older adults are willing to learn digital skills, but age-friendly instructional resources remain scarce and the digital divide persists. Fourth, although older adults and their family members generally express acceptance of smart eldercare services, complex operations and safety concerns constrain wider adoption.

5. Strategies For Improving the Age-Friendliness of Smart Eldercare Services

To address these challenges, the study proposes strategies focused on four areas: emergency safety, emotional support and companionship, digital learning, and ease of use. The proposed measures include streamlining AI-enabled smart eldercare functions, strengthening human-centered emotional services, expanding age-friendly educational resources, and simplifying operational processes. Collaboration across multiple scenarios and stakeholder groups is intended to address existing mismatches between the supply of and demand for smart eldercare services.

5.1. Improving Age-Friendly Design to Enhance Home Safety

To address the safety risks associated with home-based eldercare, the strong demand for emergency assistance, and the limited age-friendly design of existing AI-enabled smart eldercare products, the study proposes adapting smart devices and terminals to older users' needs (Guo et al., 2025; Xiong, 2025). The proposed adaptations focus on home emergency assistance and safety monitoring. Unnecessary functions should be removed, while one-touch emergency calling and risk alerts should be added. Short videos on home safety and emergency response should use large text and voice narration to support independent learning among older adults. At the community level, an integrated service model could combine online tutorials, AI-assisted emergency consultation, and in-person home assistance. These measures are intended to strengthen home-safety protections, improve the age-friendliness of smart eldercare products, and reduce risks in home-based care.

5.2. Intergenerational Companionship: Addressing Emotional Needs

To address the limitations of AI companionship services—including limited emotional responsiveness, weak contextual engagement, and an inability to replace family companionship—the study proposes a diversified intergenerational support system. Family interaction would form its core, complemented by community social activities and volunteer assistance (Wang et al., 2025; Zhao & Shi, 2024). Short-video media could provide online channels for intergenerational interaction, enabling older adults to share aspects of daily life with family members and communicate remotely. Regular interactions could help maintain emotional connections and alleviate the sense of disconnection caused by living apart (Zhou, 2014; Zhou & Ding, 2020). A community-based digital social platform could encourage older adults to document daily life through short videos, showcase personal skills, and participate in community activities, thereby expanding opportunities for social engagement (Du & Yang, 2024; Lian et al., 2026; Shen & Guan, 2025). In addition, a support mechanism involving family members and young volunteers could provide regular online companionship and in-person home visits to older adults who live alone or in empty-nest households (Wu & Jiang, 2021). This human-centered, context-sensitive approach could complement the emotional support that intelligent devices cannot provide and strengthen the humanistic dimension of smart eldercare services.

5.3. Age-Friendly Education: Bridging the Digital Divide

Although many older adults are willing to develop their digital skills, they face a shortage of age-friendly learning resources, limited learning channels, and difficulties integrating into digital environments (Wang et al., 2025). The study therefore proposes a standardized, sustainable, and lightweight system for supplying age-friendly digital-learning resources. Short videos offer several advantages: they are concise, easy to disseminate, and easy to reproduce. A comprehensive resource library could cover basic digital operations, access to online public services, online social and recreational activities, and the use of smart devices (Du & Yang, 2024; Lian et al., 2026; Tang, 2025). Content should be designed around older adults' cognitive and learning needs, using slower narration, step-by-step demonstrations, and large, highlighted text. Community eldercare centers could offer regular digital-skills classes, using standardized instructional videos as the main teaching resource and supplementing them with one-to-one guidance from volunteers and hands-on practice (Guo et al., 2025). Peer-learning groups for older adults could also provide regular digital-skills training and online-safety education. Combining self-directed learning, peer learning, and guided instruction in this way could improve older adults' digital literacy and help narrow the digital divide (Zhao & Shi, 2024; Wen, 2020).

5.4. Streamlining Operations and Strengthening Safety Safeguards

Although older adults and their family members generally express a high level of acceptance of smart eldercare services, cumbersome operations, complex system structures, and concerns about network and device security may constrain wider adoption. Volunteer teams could therefore provide practical guidance, safety education, and channels for feedback (Zheng, 2023; Liu, 2024; Xu & Xu, 2024). For operational support, volunteers could help older adults configure smart devices, close pop-up windows, add shortcuts, and learn common functions such as voice control. They could also create simple instructional videos for later reference. For safety education, large-print materials and short educational videos could explain privacy protection and fraud prevention, while volunteers could help older adults adjust device permissions to address family members' security concerns. For outreach and feedback, community demonstrations could invite older adults and their family members to try the services in person (Zhao, 2023; Liu, 2026). Difficulties encountered during use could be recorded, organized into a problem list, and regularly shared with the project team to guide service improvements, reduce barriers to adoption, and support the delivery of inclusive smart eldercare services.

5.5. A Collaborative Operating Mechanism for the Multidimensional Service System

The three core modules are intended to operate in coordination, supported by collaboration among multiple stakeholders to ensure the long-term delivery of services (Wang, 2026). These stakeholders include families, communities, social organizations, and short-video platforms. Families provide support and companionship; communities coordinate volunteer services and public outreach; and short-video platforms improve age-friendly features and provide content suited to older adults. A dynamic feedback mechanism should collect views from older adults and their family members and use them to adjust service content continuously. Such collaboration could support a low-cost, inclusive smart eldercare model and contribute to active aging.

6. Conclusions and Future Directions

6.1. Conclusions

This study examined challenges in adapting AI-enabled smart eldercare services to older adults' needs, drawing on a survey of older residents in urban communities. By combining a literature review, questionnaires, and semi-structured interviews, and drawing on the three theoretical perspectives discussed above, the study developed a smart eldercare service model that combines short videos with intergenerational collaboration. The findings suggest that older adults have diverse care needs. In addition to basic care, they have needs related to health management, online services, and social and recreational activities. Many are willing to use smart eldercare services but lack convenient learning channels, making short videos a potentially accessible learning medium. Existing smart eldercare products do not always accommodate older adults' physical and cognitive abilities, contributing to a mismatch between service supply and demand. Smart hardware alone is insufficient to meet the needs of older adults; collaboration among families, communities, and other stakeholders is also necessary. The integrated model of daily care, emotional support, and digital inclusion proposed in this study reflects these needs and may offer a low-cost reference for inclusive smart eldercare.

6.2. Limitations and Future Directions

This study has several limitations. The sample was drawn exclusively from urban communities and did not include older adults in towns or rural areas, which limits the generalizability of the findings. The proposed service model was developed through theoretical analysis and survey research but has not been evaluated through long-term community-based pilots; its practical effectiveness therefore remains to be tested. In addition, the analysis did not fully explore differences in needs across older-adult groups, and comprehensive data-validity checks have not yet been completed. These limitations indicate areas for further improvement.

Against the backdrop of population aging, AI-enabled smart eldercare is likely to become more refined and inclusive. Future efforts should deepen age-friendly adaptations, strengthen links between community-based digital support and intergenerational assistance within families, and establish a robust system for industry oversight and safety supervision. By making effective use of short videos as a lightweight medium, intergenerational eldercare models could be further developed to help narrow the digital divide, support older adults' participation in digital society, and promote active aging.

Author Contributions:

Conceptualization: X.Z, M.Y, H.H, J.L, Z.L; Methodology: Z.L; Software: M.Y, H.H, J.L; Validation: Z.L; Formal analysis: X.Z, M.Y, H.H, J.L, Z.L; Investigation: Z.L; Data curation: X.Z, H.H, J.L; Original draft preparation: X.Z, M.Y, H.H, J.L, Z.L; Writing—review & editing: H.H, J.L; Visualization: X.Z, M.Y, H.H, J.L, Z.L; Project administration: J.L; All authors have read and agreed to the published version of the manuscript.

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Not applicable.

Informed Consent Statement:

Before the questionnaire distribution and interviews, the research objectives, content, and information usage were explained to the research subjects, and all respondents voluntarily participated in the survey and interviews; The collected original data were de-identified, and no sensitive information that could directly identify individuals was retained.

Data Availability Statement:

Relevant materials for this study may be obtained upon request from the corresponding author. To protect the personal information of respondents, original questionnaires and interview records will not be disclosed; Aggregated data and analysis results after desensitization will be provided under reasonable application conditions.

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Conflict of Interest:

The authors declare no conflict of interest.

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