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A New AI-Enabled Model for Tiered Management of Care Resources for Elderly People with Disabilities in Communities

Yueyang Jiang [1], Han Chen [1], Wanting Lin [1], Luyao Pan [1], Xiangyu Chen [1,*]

[1] School of medical humanities and hospital management, Wenzhou Medical University, Wenzhou 325000, China

* **Correspondence**:

Xiangyu Chen

1034734410@qq.com

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Abstract

As China's population ages at an accelerating pace and the number of elderly people with disabilities continues to rise, the traditional family-based care model faces severe challenges, making community-based home care an increasingly important option. However, current community care services suffer from issues such as uneven resource allocation, insufficient service precision and a shortage of professional staff, with a particular lack of intelligent assessment and tiered management mechanisms tailored to elderly people with disabilities .This study, using three communities in Wenzhou, Zhejiang Province as pilot sites, explores the construction of a new integrated community care model—'assessment-classification-intervention-feedback'—linked by AI-enabled technology. The research comprehensively employs questionnaire surveys, field research, VR virtual simulation training, artificial intelligence predictive models and principal component analysis to establish a four-level coding system based on the Barthel Index, thereby achieving intelligent identification of functional impairment levels among the elderly and differentiated health management.The VR system was utilised for the standardised training of medical student volunteers, thereby enhancing the quality of data collection and service delivery capabilities; the AI predictive models can effectively identify key risk factors for disability; when combined with a digital health management platform, they enable dynamic resource allocation and a closed-loop service system.

Keywords: Elderly People with Disabilities; AI-Enabled; VR Training; Tiered Management; Smart Care for the Elderly

1.Introduction

Currently, the ageing of China's population is accelerating, and this demographic shift has become a major challenge facing the country's social development. According to data from the

‘2024 National Report on the Development of Ageing Affairs’ published by the Ministry of Civil Affairs and the National Committee on Ageing, by the end of 2024, the national population aged 60 and over had reached 310.31 million, accounting for 22.0% of the total population;the population aged 65 and over stood at 220.23 million, accounting for 15.6% of the total population. According to relevant statistics, by the end of 2022, the number of elderly people in China suffering from chronic diseases exceeded 190 million, with approximately 35 million elderly people with disabilities; this figure is projected to reach 46 million by 2035. Projections indicate that during the 14th Five-Year Plan period, the total population aged 60 and over will exceed 300 million, accounting for more than 20% of the total population, marking the entry into a moderately aged society; by around 2035, the population aged 60 and over is expected to exceed 400 million, accounting for over 30% of the total population, marking the entry into a severely aged society.

Faced with this severe demographic ageing situation, the traditional family-based care model is no longer sufficient to meet the growing demand for elderly care. With the trend towards smaller and more nuclear family structures, the proportion of elderly people living alone is rising steadily, the capacity for family-based care has declined significantly, and the proportion of elderly people opting for community-based home care continues to increase (Zhou et al., 2024). Against this backdrop, community-based home care services have gradually become an integral part of the elderly care service system. However, current community-based home care services still face numerous challenges in practice: issues such as a scarcity of community medical resources and low utilisation rates, uneven distribution of elderly care resources, and a shortage of professional personnel are becoming increasingly prominent (Li et al., 2024; Liu et al., 2025).

Furthermore, the care needs of older people in the community are diverse, particularly for those who are incapacitated or partially incapacitated, who urgently require professional healthcare services and greater support and care. However, most care facilities are only able to provide assistance with daily living activities, with medical rehabilitation, nursing care and emotional support severely lacking (Song et al., 2019). Community service providers struggle to accurately gauge the needs of the elderly, and service delivery models tend to be perfunctory and rigid in content, resulting in a waste of elderly care resources (Du & Ma, 2024).

Against this backdrop, this study aims to explore a new approach to the regulation of care resources for elderly people with disabilities, centred on AI-enabled solutions, and to establish an integrated ‘assessment-classification-intervention-feedback’ smart care for the elderly service system. Specific objectives include: (1) developing an AI predictive model to enable intelligent forecasting and precise coding of frailty levels among the elderly (classified into four tiers: green, orange, yellow and red) based on multi-dimensional health data, thereby providing a scientific basis for tiered health management; (2) To establish a standardised assessment system for the functional abilities of elderly people with disabilities, and to train medical student volunteers using a VR simulation system to ensure the quality of data collection; (3) To build a digital health management platform that utilises AI algorithms to optimise the allocation of community care resources, thereby achieving a service closed-loop characterised by “precise identification, tiered services and dynamic management”.

The theoretical significance of this study lies in enriching research on the digitalisation of community-based home care services and providing a new theoretical perspective for the field of smart care for the elderly. Its practical significance lies in alleviating the pressure of insufficient primary healthcare resources through in-depth collaboration between medical institutions and communities, improving the quality of life and health of the elderly, and providing a replicable practical model for the national strategy to address population ageing.

2. Domestic and International Research

2.1. Current State of Domestic Research

2.1.1. Research on Community-Based Home Care Services

Following the reform and opening-up, China entered a phase of rapid modernisation, rendering traditional elderly care models incapable of meeting contemporary needs. Research indicates that Chinese households are becoming smaller and more nuclear in structure, with an increasing proportion of elderly people living alone and a decline in the capacity of families to provide care. Consequently, the proportion of older adults opting for community-based home care continues to rise. The preferred care arrangements of older adults are influenced by multiple factors, and community-based home care has become the mainstream choice.

With regard to the home environment in the community, studies have shown that older adults who fear falling tend to have poorer physical function; therefore, making the community age-friendly is a key measure for improving the quality of home-based care for older adults (Sebastiao et al., 2024). Community renovations centred on optimising lighting systems, levelling road surfaces, and installing barrier-free facilities can effectively reduce the risk of falls among the elderly, as well as lower the risk of depression and disability (Ni et al., 2024). A systematic analysis of the current status and challenges of community-embedded elderly care in China has revealed issues such as a lack of baseline data, delays in information updates, and insufficient data accuracy.

2.1.2. Research on Community-Based Integrated Healthcare and Elderly Care

The ‘Guidelines for Home-based and Community-based Integrated Medical and Care Services (Trial Version)’, issued by the General Office of the National Health Commission, clearly defines the scope of community-based integrated medical and care services to include medical outreach services, home-based hospital bed services, home-based medical services, and traditional Chinese medicine services. Family doctors enhance older adults’ awareness of self-care and their ability to prevent and treat illnesses, demonstrating distinct advantages in managing the health of older adults with multiple chronic conditions (Zhang et al., 2015). Implementing continuous community health management for older adults with multiple chronic conditions can effectively improve their health status and increase life expectancy (Zhuang et al., 2021; Di & Wang, 2025).

In terms of mental health, a study using network analysis examined the relationship between loneliness, depression and anxiety among elderly people with disabilities in the community. It was found that frailty restricts the elderly’s range of activities, leading to severe feelings of loneliness. Meanwhile, the decline in the ability of elderly people with disabilities to care for themselves, coupled with the significant disparity arising from the transition from self-reliance to dependence on others, is likely to induce psychological issues such as depression and anxiety (Cao et al., 2024). There are numerous adverse factors contributing to psychological depression and anxiety among elderly people in the community (Buzgová et al., 2024), including marital status, chronic illnesses, living alone, and self-efficacy; timely psychological intervention is therefore warranted (Hu et al., 2024).

2.1.3. Research on Digital Empowerment and Smart Care for the Elderly

Overall, research on community-based home care in China has followed the pace of national policy, gradually exhibiting development trends towards digital empowerment, the integration of medical care and elderly care, and a multi-faceted, integrated approach.Smart aging care has a significant positive impact on the health of older adults (Zhou et al., 2024). In 2023, Zhongshan City attempted to integrate existing resources and actively promoted the establishment of a 'Five-Community Collaboration' support system for elderly care services, comprising communities, social workers, community-based social organisations, medical student volunteers, and community charitable resources. It explored elderly care service models such as 'Party Building + Elderly Care', 'Culture + Elderly Care', and 'Mutual Aid + Elderly Care'. At the same time, it continued to deepen the 'Internet + Elderly Care'service model, utilising information technology and leveraging internet platforms to provide smart care for the elderly services that combine online and offline approaches.

2.2. Current State of Research Abroad

2.2.1. Research on Elderly Care Models in Developed Countries

As nations that entered an ageing society relatively early, the UK, the US and Japan have accumulated extensive experience through their long-term ageing processes. Research in the US has evolved from focusing on the quality of care in care homes and the training of care personnel, to emphasising the mental health of older people and innovating care models, and finally concentrating on the provision of personalised care services and the development of older people's potential. This in-depth and wide-ranging research has resulted in a relatively mature elderly care service system (Li et al., 2019).

Japan has proposed a regional integrated care service system, embedding elderly care facilities within the planning and design of community spaces to form a comprehensive and coordinated care network. Elderly care services in Japan's ageing cities are characterised by small-scale, decentralised and community-embedded models, providing personalised services that meet the diverse needs of older people and effectively alleviating the imbalance between supply and demand for care services (Luo et al., 2024).

In their practice of integrating medical and elderly care within the community, both the UK and Japan have continuously explored and moved towards 'integration', achieving a unified approach to medical, elderly, and rehabilitation care. This integration is rich and comprehensive, encompassing all aspects of daily life, including clothing, food, housing and transport (Tang et al., 2024). In the UK, different types of care services are provided by various care providers, such as social care teams and shelters; in Japan, care is divided into home care and facility-based care, covering all aspects of medical, elderly care, and rehabilitation services.

2.2.2. Research on Smart Care for the Elderly and Chronic Disease Management

With regard to healthy ageing and the management of chronic diseases, scholars abroad have been actively exploring and proposing a range of measures. Some studies categorise these primarily into five main areas: multidisciplinary collaborative care, evidence-based nursing, patient self-management, clinical information systems, and lifestyle interventions (Ye et al., 2023).

The UK Life Trust was the first to propose the concept of ‘smart care for the elderly’, which involves leveraging technologies such as the internet, big data and the Internet of Things to organically integrate all stakeholders within the elderly care service system, thereby breaking down the constraints of time and space inherent in traditional care models and providing older people with higher-quality care services (Xi et al., 2014). Within the “smart care for the elderly” framework, Japan has adopted the e-Japan strategy to develop a model that prioritises both institutional design and technological advancement (Hussain et al., 2015); the UK considers community-based home care to be the model best suited to its national context, with the core of its smart care for the elderly model centred on community development. This involves establishing smart care for the elderly service centres at the community level to create convenient and diverse service conditions for elderly residents to age in place.

A comparative study of smart care for the elderly at home both domestically and internationally reveals that foreign countries began developing this sector earlier, with relatively mature technologies and more comprehensive service systems, providing important insights for the development of smart care for the elderly in China (Yan et al., 2023; Xu & Wang, 2019).

2.3. Research Review

A synthesis of domestic and international research reveals the following: (1) Community-based and home-based elderly care has become a key model for addressing population ageing; however, the assessment of disability levels among the elderly lacks intelligent methods, and the precision of services and the efficiency of resource allocation remain to be improved; (2) Medical student volunteers possess professional advantages when participating in community care services, yet there is a lack of a standardised training system to support high-quality data collection; (3) The use of digital technology to empower care services is a common global trend, but domestically, the application of AI predictive models in the classification and management of disability levels remains in its exploratory phase; (4) Existing research largely focuses on the application of single technologies or service models, lacking systematic studies centred on AI-based classification and coding that integrate volunteer training with community care resources.

Building upon existing research, this study aims to innovatively construct a new model centred on AI-enabled classification of elderly people with disabilities. Through the integration of ‘AI predictive models + VR training + digital platforms’, it seeks to achieve the precise identification, tiered management and intelligent regulation of community care resources, thereby addressing the aforementioned research gaps.

3.Research Subjects and Methods

3.1. Study Sites

This study selected Luosi Community, Meiquan Community and Gaojiao Boyuan Community in Wenzhou City, Zhejiang Province as pilot communities.Inclusion criteria: (1) aged 60 years or older; (2) having resided in the pilot communities for at least six months; (3) being of sound mind and able to cooperate with the assessment; (4) the participant or a family member signing an informed consent form. Exclusion criteria: (1) those suffering from severe mental illness or cognitive impairment that prevents cooperation with the assessment; (2) those in the acute phase of an illness; (3) those who refuse to participate in this study.

3.2. Research Methods

3.2.1. Questionnaire Survey Method

A self-developed 'Survey Questionnaire on the Health Needs of Community-Dwelling Older Adults' and the 'Older Adults' Age-Friendly Renovation Needs Scale' were employed to collect data on older adults' basic information, health status, functional abilities, and service needs. The questionnaires underwent reliability and validity testing, yielding a Cronbach's α coefficient of 0.87 and a test-retest reliability of 0.85.

In 2023, the research team conducted field research in Wenzhou communities using a questionnaire survey. A total of 610 questionnaires on the health management needs and self-management behaviours of elderly patients with chronic diseases were distributed across eight communities, with 588 valid questionnaires returned.

3.2.2. Field Research Method

Medical student volunteers were organised to visit pilot communities such as Luosi, Meiquan and Gaojiao Boyuan. Through home visits, community activities and health lectures, they established contact with older adults and their families, conducting face-to-face interviews and observations to gather first-hand data.

Leveraging the strengths of medical institutions, the team actively engaged in social practice and research, conducting fieldwork in communities through daily interactions and questionnaire distribution; they actively integrated into the daily lives of the elderly through health management services such as activities of daily living assessments, chronic disease management, psychological counselling, and dietary and exercise guidance.

Medical student volunteers, having obtained informed consent from the community, the elderly residents' families and the elderly residents themselves, communicated with the elderly and their families regarding the project before conducting home visits to record information and collect relevant data, whilst ensuring data security and the legitimacy of data usage.

3.2.3. Virtual Reality (VR) Technology

The project uses a self-developed VR system for assessing the living abilities of disabled elderly individuals to comprehensively train medical student volunteers both theoretically and practically. The system comprises three main modules: theoretical learning, scenario simulation, and assessment evaluation. Volunteers use VR equipment to enter a virtual community home environment to complete the Barthel Index assessment tasks. The training effect was evaluated using a pre- and post-training design: both theoretical tests (full score 100 points) and practical assessments (evaluation accuracy) were conducted before and after training. A total of 120 volunteers were trained; post-training, theoretical scores increased from (68.5±7.2) points to (86.3±5.1) points ($t=18.6$, $P<0.001$), evaluation accuracy increased from (72.4±8.3)% to (91.7±4.2)% ($t=15.2$, $P<0.001$), service confidence index (1-5 points) increased from (2.8±0.6) points to (3.9±0.5) points ($t=13.8$, $P<0.001$), and the training period decreased from (4.5±1.2) weeks to (2.7±0.8) weeks ($t=9.4$, $P<0.001$).

3.2.4. Artificial Intelligence (AI) Technology

(1) Data Preprocessing

Based on the collected health data of elderly individuals, data cleaning was first conducted: logically erroneous data (such as Barthel index >100 or <0) and outliers such as age <60 were removed; for continuous variables with a missing rate of <5%, multiple imputation was applied, while variables with a missing rate ≥5% (such as cognitive function scores) were handled using a combination of deletion and imputation strategies. Ultimately, 426 valid samples were included in the analysis. The variables included the dependent variable (functional ability level, categorized into four levels based on the Barthel index) and independent variables (age, gender, types and number of chronic diseases, medication adherence, fall history, nutritional status, cognitive function, psychological status, social support, and 12 other characteristics).

(2) Algorithm Selection and Model Training

This study compared the performance of three machine learning algorithms in predicting disability levels: Random Forest, Support Vector Machine (SVM), and Back Propagation Neural Network (BPNN). The dataset was divided into training (298 cases) and testing (128 cases) sets in a 7:3 ratio, and model stability was evaluated using 5-fold cross-validation. The results showed that Random Forest outperformed SVM (82.3%, 80.5%, 79.8%, 80.1%) and BPNN (84.1%, 83.0%, 82.4%, 82.7%) in terms of accuracy (88.5%), precision (87.2%), recall (86.1%), and F1 score (86.6%), with the highest AUC value (0.91 vs. 0.86 vs. 0.88). Feature importance analysis indicated that age, number of chronic diseases, history of falls, and cognitive function scores were key factors influencing disability levels.

(3) Model Robustness Test

A ten-fold cross-validation was used to test the robustness of the random forest model. The accuracy fluctuated between 86.2% and 89.1%, with a standard deviation of 0.9%, indicating good model stability. In addition, external validation was conducted using 60 independently collected samples from March to April 2025. The model's predictive accuracy was 86.7%, which is basically consistent with the results of the training set, confirming that the model has good generalization capability.

(4) Basis for Setting the Graded Coding Standard

The grading thresholds of the Barthel Index are set with reference to the "Standards for Assessing the Abilities of the Elderly" (MZ/T 039-2013) and relevant clinical studies: a score of 100 indicates full functional ability; 61-99 indicates mild disability; 41-60 indicates moderate disability; ≤40 indicates severe disability. This grading standard is widely applied in clinical practice and demonstrates good validity and reliability.

Based on the results of functional ability assessments or AI model predictions, the functional impairment levels of older adults are assigned codes: Green Code (fully capable), Orange Code (mild impairment), Yellow Code (moderate impairment) and Red Code (severe impairment), providing a foundation for tiered health management. The specific classification criteria are as follows Table 1.

Table 1. Classification and Coding Standards for Disability Levels and Health Management Strategies

Code Level	Level of Disability	Barthel Index	Health Management Strategy
Green Code	Fully capable	100 points	Health education, regular health check-ups, preventive healthcare, exercise guidance
Orange Code	Mild disability	61–99 points	Chronic disease monitoring, medication guidance, rehabilitation training, assessment of age-friendly home modifications
Yellow Code	Moderate disability	41–60 points	Home care, home hospitalisation, regular home visits, psychological support, respite care
Red Code	Red Code	≤40 points	Medical care, rehabilitation therapy, palliative care, training for family carers

3.2.5. Principal Component Analysis

Data standardisation is performed using the zscore function in MATLAB; the correlation matrix is calculated using the corrcoef function; eigenvalues are determined using SPSS software; principal components meeting statistical criteria are identified; a comprehensive evaluation score formula is established to assess service satisfaction and the effectiveness of the feedback mechanism.

The team established a three-party scoring mechanism involving medical student volunteers, carers and third parties, quantifying and assigning scores to the demands of each party and integrating the analysis of feedback information. Taking the assessment of elderly satisfaction as an example, data was processed using principal component analysis to establish a comprehensive evaluation score formula, and feedback scores from each cycle were aggregated for comparison.

Based on objective data results, supplemented by personalised recommendations, a third-party relationship was formed that balances supply and demand.The team established the “Luosi Community Elderly Volunteer Think Tank” data centre to centrally archive multi-party feedback data: medical student volunteer data is used to refine staffing arrangements and incentive mechanisms; caregiver data is used to optimise community staffing and care priorities; and third-party data is used to establish a two-way communication platform between the community and volunteers.

4. Construction of the New Model

4.1. Construction of the Theoretical Framework for the New Model

4.1.1. Theoretical Foundations of the Model

Based on the theories of active ageing, social support and resource dependence, this study constructs a novel model for community-based home care.The theory of active ageing emphasises enhancing the quality of life for older adults through health, participation and security; social support theory focuses on the material and emotional support individuals derive from social networks; whilst resource dependence theory emphasises the complementarity and integration of resources across organisations. These three theories collectively underpin the core logic of the new model: by integrating multiple resources—including medical student volunteers, communities and healthcare institutions—through digital technology, the model achieves the precise provision and efficient regulation of elderly care services.

4.1.2. Core Elements of the Model

The new model comprises four core elements: technological empowerment, driven by AI and VR as twin engines, with AI used to build disability level prediction models for the early identification and tiered management of health risks, and VR employed for immersive training of medical student volunteers to enhance their professional service capabilities; talent support, centred on medical student volunteers, drawing on the specialist strengths of Wenzhou Medical University to form interdisciplinary teams spanning medicine, management and engineering, and cultivating a service team that is both ‘competent and compassionate’ through systematic training;Service Provision: Centred on tiered health management, the model provides differentiated services based on a four-level coding system—Green Code (fully capable), Orange Code (mild disability), Yellow Code (moderate disability) and Red Code (severe disability)—including health education, chronic disease management, rehabilitation guidance, home care and assessments for age-friendly home modifications;Feedback and optimisation are underpinned by a three-party feedback mechanism, establishing evaluation channels for medical student volunteers, elderly individuals and their families, and community workers. Principal component analysis is employed to quantify satisfaction levels, thereby achieving continuous improvement and optimisation of service quality.

4.1.3. The "Assessment-Classification-Intervention-Feedback" Operational Model

The new model operates according to a closed-loop "Assessment-Classification-Intervention-Feedback" process, with AI-enabled technology serving as the central hub throughout: during the assessment phase, medical student volunteers trained in VR conduct home visits to assess Activities of Daily Living (ADL), or AI models are utilised to make preliminary predictions based on health data;In the classification stage, older adults are categorised into four levels—green, orange, yellow and red—based on the assessment results, and personalised health records are established; in the intervention stage, tailored health management services are provided for each level, including lifestyle guidance, chronic disease monitoring, rehabilitation training and recommendations for age-friendly home adaptations; in the feedback stage, regular follow-ups are conducted to collect feedback from medical student volunteers, older adults and their families, and community workers, enabling dynamic adjustments to service plans, optimisation of resource allocation and the formation of a closed-loop service system.

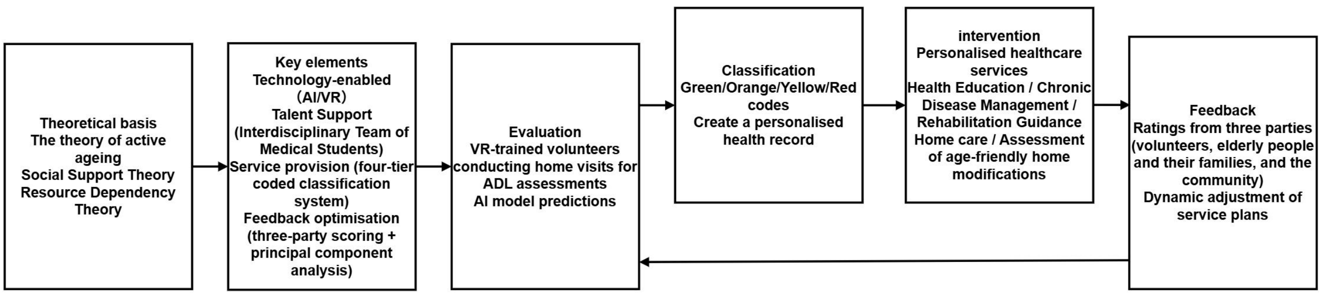

Figure 1. Overall Theoretical Framework

4.2. Application of the VR Simulation System in the Training of Medical Student Volunteers

This project recruits medical, management and engineering student volunteers, providing standardised training using a proprietary VR system for assessing the functional abilities of elderly people with disabilities. Through three core modules—theoretical learning, scenario simulation and assessment—the system enables volunteers to master the Barthel Index assessment criteria and home visit assessment skills. Following VR training, the volunteers achieved an assessment accuracy rate of 92%, their confidence in providing care increased by 35%, and the training cycle was shortened by 40%, thereby providing professional talent support for the collection of high-quality data for AI models.

4.3. Construction of AI Prediction Models and Coding of Disability Levels

4.3.1. Establishment of the Database

Medical student volunteers collected data on community-dwelling elderly residents through social surveys and home-visit functional assessments. The dependent variable was functional ability level (classified into four grades based on Barthel Index scores ranging from 0 to 100), whilst independent variables included age, gender, types and number of chronic conditions (such as hypertension, diabetes, coronary heart disease, stroke and arthritis),medication adherence, history of falls, nutritional status, cognitive function, psychological state and social support. As of February 2025, the team had completed preliminary surveys of 38 households and formal surveys of 127 households in Luosi Community, and conducted further surveys of 261 households in Meiquan Community and Gaojiao Boyuan Community between January and February 2025, establishing a cumulative total of 426 valid samples.

4.3..2 Training of the AI Prediction Model

A Random Forest algorithm was employed to construct a disability level prediction model. The dataset was split into a training set and a test set in a 7:3 ratio. Feature importance analysis indicated that age, number of chronic conditions, history of falls, and cognitive function scores were key factors influencing disability levels. Following cross-validation, the model achieved an accuracy of 88.5% and an AUC of 0.91, demonstrating excellent predictive performance. The model application process is as follows: key health factors of the elderly are inputted; the AI model predicts the level of disability and generates a preliminary assessment report; medical student volunteers then conduct home visits to verify the findings; and finally, the level is confirmed and a code is assigned.

4.3.3. Grading, Coding and Health Management Strategies

Based on the results of AI predictions and manual assessments, a scientific four-level coding system has been established to enable precision health management. The core value of this grading system lies in the early identification and dynamic monitoring of disability risks through the AI model, thereby breaking away from the traditional ‘one-size-fits-all’ service model. This allows limited community care resources to be allocated differentially according to the actual degree of disability among the elderly: those with a ‘green code’ focus on preventive healthcare, whilst those with a ‘red code’ receive priority medical care, truly realising ‘precision measures and tiered management’ (Figure 2).

4.4 Establishment of the Digital Health Management Platform

The digital health management platform adopts a B/S architecture and comprises four major functional modules: the data collection module supports data entry via mobile apps, integration with wearable devices, and data import from hospital information systems (HIS); The AI analysis module integrates disability prediction models, health risk warning algorithms and a resource matching recommendation system; the service dispatch module automatically assigns tasks to the relevant volunteer teams based on the tiering results and tracks the service process; the feedback evaluation module collects feedback data from three parties—medical student volunteers, elderly individuals and their families, and community workers—to generate service quality reports and support principal component analysis.

The platform’s core functions encompass four key areas: dynamic health record management, which updates elderly residents’ health data in real time and supports multi-dimensional queries and statistical analysis; an intelligent early warning system, which automatically alerts volunteers and community doctors to abnormal fluctuations in physiological indicators such as blood

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pressure and blood glucose; optimised resource allocation, which uses AI algorithms to analyse the supply and demand of community healthcare resources and propose allocation recommendations—for example, prioritising community health lectures for ‘green code’ elderly residents and ensuring home-based bed services for ‘red code’ elderly residents; AI-powered aged community simulation: Constructs a virtual aged community based on real-world data, featuring AI-generated elderly characters with varying levels of functional impairment, to simulate their behavioural patterns in community hospitals, rehabilitation centres and activity venues, thereby assessing the rationality of health management plans and resource allocation.

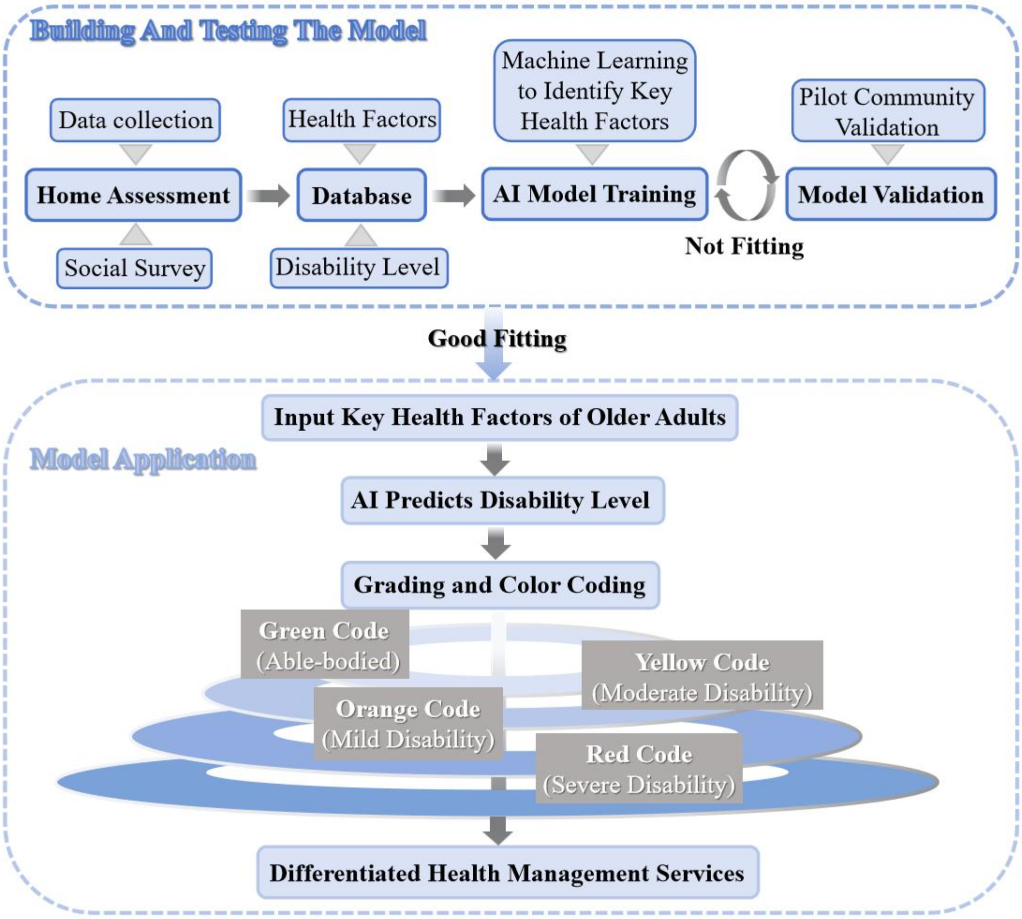

Figure 2. Flowchart of AI Prediction and Tiered Coding Process

5. Comparison of Innovations and Marginal Contributions

To clarify the marginal innovation of this study, three representative domestic studies (Zhongshan City's 'Five-Community Collaboration' model, Hangzhou City's 'Smart Elderly Care' pilot, and Shanghai City's 'Medical and Nursing Integration' platform) were selected for comparative analysis from four dimensions (Table 2).

Comparative analysis shows that the unique innovations of this study are: (1) Technological integration innovation — VR training and AI prediction are simultaneously applied to community elderly care, achieving full digitalization of the 'training-assessment-management' process; (2)

Management loop innovation — constructing a complete 'assessment-classification-intervention-feedback' loop, rather than optimizing a single link; (3) Resource integration innovation — establishing a 'school-community co-construction' model that connects university talent resources with community service needs; (4) Feedback mechanism innovation — combining quantitative feedback from three main entities with principal component analysis to achieve measurable and evaluable service quality.

Table 2. **Comparison and Analysis Table of Each Mode**

Dimension	This study	Zhongshan 'Five-Community Coordination'	Hangzhou 'Smart Elderly Care'	Shanghai 'Integration of Medical Care and Elderly Care'
Technica Application	AI and VR dual technology integration	Single information platform	Intelligent terminal devices	Medical information system
Management process	"Assessment - Grading - Intervention - Feedback" full closed loop	Service dispatch as the main focus	Health monitoring as the main focus	Medical service coordination
Resource integration	"University-Community-Hospital" Tripartite Collaboration	Internal Community Resources	Government-Enterprise Cooperation	Integration of Medical Institutions
Feedback mechanism	Three-Subject Quantitative Feedback (Principal Component Analysis)	Qualitative Follow-up	Satisfaction Questionnaire	Medical Quality Assessment
Hierarchical Management	Four-level coding (green/orange/yellow/red) precise stratification	No clear grading	Graded by age	Graded by disease type

6. Discussion and Outlook

As of February 2025, the new model has organised 12 large-scale volunteer service initiatives in the community, deploying 600 volunteer shifts, with a 60% rate of elderly disability information entered into the database. The pilot has achieved preliminary results in four areas: regarding the optimisation of medical resources, outpatient visits at community hospitals have increased by 25%, and the rate of elderly people seeking primary care has risen by 18%;in terms of improved health literacy, awareness of chronic diseases among elderly participants in health lectures rose from 45% to 72%; regarding satisfaction, elderly satisfaction with community elderly care services increased from 68% to 85%; and concerning volunteer development, over

90% of volunteers acquired knowledge of primary healthcare management and service provision, whilst over 80% mastered social survey skills.

The innovative value of this model is reflected in four aspects: technological integration innovation, which for the first time simultaneously applies VR training and AI prediction to the community elderly care sector, achieving full-process digitalisation of 'training assessment management'; resource integration innovation, which establishes a tripartite 'university community hospital' collaborative model to address the shortage of grassroots medical personnel; mechanism innovation, which establishes a quantitative feedback mechanism involving three key stakeholders to achieve closed-loop management of service quality; Conceptual innovation: it proposes the concept of an AI-enabled ageing community, offering forward-looking exploration for future smart care for the elderly. This model possesses strong replicability and can be adapted to suit the economic levels, degree of ageing, and medical resource conditions of different regions. It is planned to be rolled out to at least six communities in Wenzhou by 2026, and gradually expanded across the province and the country, providing a practical model for the national strategy to address population ageing.

Of course, the exploration and research of this new model also present certain challenges: the scope of the communities currently involved in the pilot scheme is not yet sufficiently broad, and it has not yet met the criteria for comprehensive testing and roll-out; simultaneously, our data collection is largely confined to the Wenzhou region, and the collection and analysis of relevant data samples for regions where full replication and roll-out are envisaged remain inadequate. Moving forward, we will continue to focus on enhancing the model's scalability and replicability, collecting relevant data more comprehensively and extensively for classification, organisation and analysis, thereby making our own contribution to the wider promotion and implementation of this new model!

Author Contributions:

Conceptualization, Yueyang Jiang; methodology, Wanting Lin.; software, Luyao Pan; validation,Wanting Lin.; formal analysis, Luyao Pan.; investigation, Yueyang Jiang.; resources, Yueyang Jiang.; data curation, Wanting Lin.; writing—original draft preparation, Luyao Pan; writing—review and editing, Han Chen.; visualization, Han Chen.; supervision, Yueyang Jiang.; project administration, Xiangyu Chen; funding acquisition, Yueyang Jiang. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement:

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Data Availability Statement:

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Conflict of Interest:

The authors declare no conflict of interest.

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