

# Research on home care model of intelligent community based on SD model -- Taking Meilin community as an example

Jun Ma<sup>1,a</sup>, Yanqing Chen<sup>2,b</sup>

<sup>1</sup>School of Management, Tianjin University of Technology, China

<sup>2</sup>School of Management, Tianjin University of Technology, China

<sup>a</sup> ma\_jun9@126.com, <sup>b</sup> chenyanqingchh@126.com

**Abstract.** The problem of aging has appeared in some countries, and the problem of providing for the aged has become one of the key issues. In recent years, aging has also become a social problem in China, but the current pension model can not meet the diversified and personalized needs of the elderly in China. In this paper, the intelligent community home-based elderly care model has become the forefront of academic research and a new topic of elderly care practice. On this basis, this paper sorts out the research context of the home-based elderly care model in smart communities, and uses Maslow's Hierarchical Needs Theory (MHNT) and Welfare Pluralism Theory (WPT) as research methods to analyze the needs of the elderly and the choice of welfare providers. In addition, this paper uses the method of system dynamics to establish a model to analyze the supply and demand balance of different pension models, and demonstrates the advancement of community home-based pension model. Finally, through the interview and investigation of the staff and managers of the smart community home-based elderly care model in Meilin community, Dongzhi County, Anhui Province, China, this paper summarizes the existing elderly care model in the community, and finds some deficiencies, such as the lack of full-time personnel, the inadequate use of new technologies and the lack of financial support. According to this, the paper puts forward corresponding countermeasures: (1) the problems of personnel can be solved by strengthening the training of service personnel, improving the system of volunteers and community service personnel working together, etc.; (2) The problem of technology application can be solved by cooperating with external enterprises or other organizational units in research and development; (3) In terms of financial support, it is necessary to broaden the channels of obtaining funds, seek the cooperation of enterprises, and adopt the innovative pension service mode of charging for providing high-end services and using the income for public welfare free basic services to effectively raise funds. Through the above research, the authors can put forward solutions to the pension problems faced by Meilin community, integrate relevant resources, and reduce the social burden.

**Keywords:** Population aging, Smart community home care, Hierarchical Demand Theory, Welfare Pluralism Theory, System Dynamics.

## 1. Introduction

According to the statistical bulletin of China's health development in 2021 [1] released by the National Health Commission, the average life expectancy of China's people in 2021 has reached 78.2 years, and the main health data are in the forefront of high-income countries. According to the United Nations' standards for an aging society (a country or region with a population older than 65 years old reaching 7% of the total population means it has entered an aging society; if it reaches 14%, it is a deep aging society), China officially entered an aging society at the beginning of this Century (2000) [2]. However, the current community home-based elderly care model is still in its infancy. The community home-based elderly care model combined with "Internet +" needs systematic research. After analyzing the background of population aging in China, this paper reviews the research on community home-based care at home and abroad, and gives the mainstream definition of related concepts of community home-based care; Then it demonstrates the research of this paper through Maslow's Hierarchical Needs Theory and multiple welfare theory; Finally, combined with the specific case of Meilin community, this paper analyzes the current situation of community elderly care service and finds problems, so as to give countermeasures.

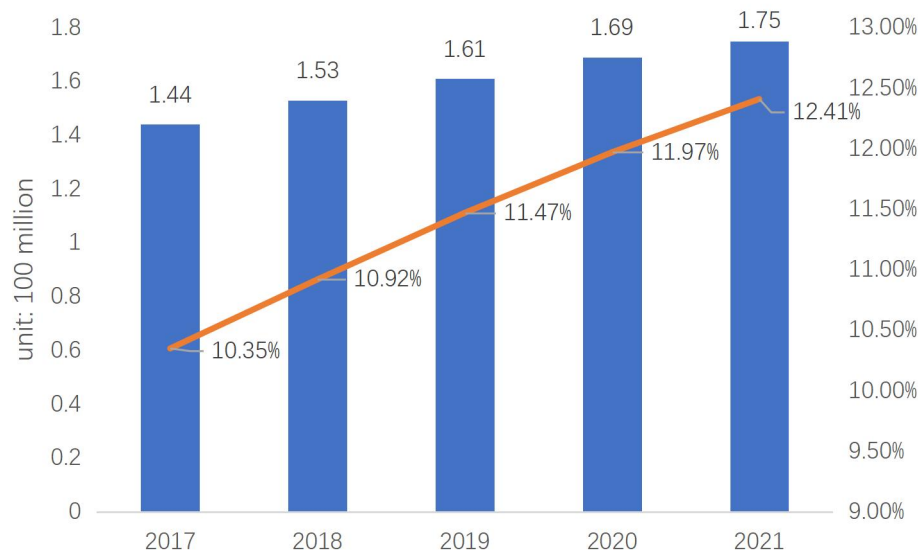


Figure 1 Number and proportion of elderly population in China in recent five years

## 2. Research status

The concept of community care for the aged was first put forward by the UK in the 1950s, also known as community care. The white paper on community care issued by British scholars in 1989 explains the connotation of community care [3], and describes the blueprint for community care, that is, the community pension model. The British community care model is mainly divided into two parts, namely "care within the community" and "care by the community". The former refers to that the elderly can accept the services brought by professional medical staff at home or in the elderly care institutions in the community, such as maintenance services, life care, etc., and the service subject is the government or public welfare institutions with legal norms; The latter refers to that the elderly's family members, relatives or unrelated friends, caring groups and volunteers take the initiative to find elderly groups with pension related needs for living and other care services. This way has no fixed service subject, and is mainly based on mutual help between people. It is a kind of preventive pension care. For community care, parrott[4], schopflin[5], sharkey[6] analyzed the optimization strategy of the pension model.

Under the guidance of this model, Chinese scholars have also proposed different pension models, such as self pension, family pension and social pension according to different pension providers [7]; According to different sources of funds, it can be divided into three types: individual pension, social pension and government pension [8].

In today's "Internet +" context, the traditional means of providing for the aged cannot easily, quickly and efficiently meet the needs of the elderly, and it is difficult to improve the quality of elderly care services. Therefore, the introduction of "Internet +" and other intelligent technologies, such as online consultation, on-site physical examination, online ordering, etc., to assist the community pension has become a major trend. In fact, this idea was mentioned by many scholars as early as the 1980s. It is called "geriatric technology" in the academic community, including the knowledge system of geriatric medicine and emerging technologies. Geriatrics is the process of studying the health of the elderly; Emerging technologies are used to assist the elderly through scientific and technological means. In the research in this field, bock and other scholars pointed out that technology for the elderly is an auxiliary means to improve the quality of life of the elderly by combining new technologies [9]; In addition, some scholars, such as Kearns, believe that the application of new technologies to the elderly is a new concept, and it is necessary to formulate perfect laws and regulations for this purpose [10]. Chinese government departments have also

realized that smart pension is the trend of future pension, and issued a series of policies, as shown in Figure 2.

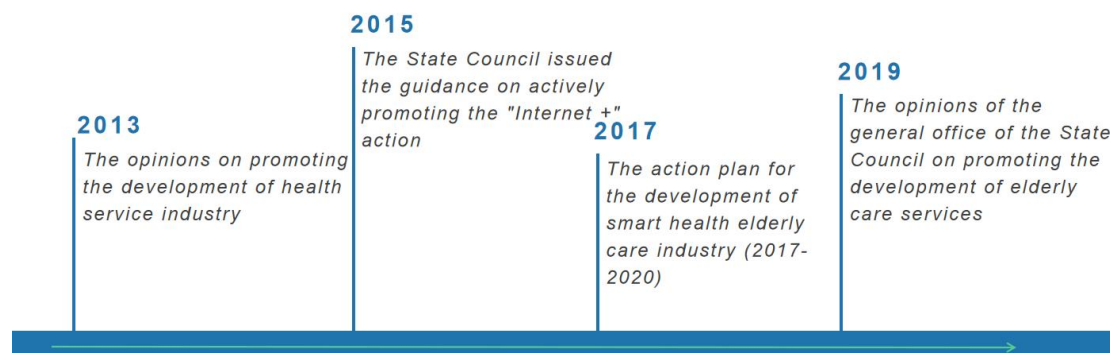


Figure 2 Time Line of China's "Internet +" community pension related policies

According to the results of literature research, although our government departments have issued various policies to speed up the promotion of "Internet +" community pension, there are still some problems in the application status of "Internet +" community pension: (1) the development is unbalanced. The areas with better development of community elderly care are concentrated in economically developed areas such as the eastern region, while the development of community elderly care services in the central and western regions is still low; (2) The use of new technologies such as the Internet is not thorough enough. At present, most of the technologies used in community elderly care centers are traditional GPS positioning, which is difficult to provide comprehensive and high-quality "Internet +" elderly care services. In this regard, Yu Xiao and others believe that the combination of Internet and elderly care services has its advantages, but it can not achieve the expected effect at this stage [11]. Wanglili believes that the current community home-based elderly care model in China cannot meet the personalized needs of the elderly, and there are still contradictions between the supply and demand sides [12]. In addition, liuquansheng and others explained from the aspect of facility configuration that the existing equipment and products for community elderly care in China are not intelligent enough to provide satisfactory services for the elderly [13]. To sum up, strengthening the combination of "Internet +" and home-based care is the new trend of the future pension model.

### 3. Research methods

Only by meeting the personalized needs of the elderly, can we fundamentally realize the purpose and value of pension services. Whether the pension model can meet the growing personalized needs of the elderly is one of the key links in the evaluation system of the pension model. This is also the application scenario of MHNT. However, due to the growth of age and the degradation of their own physical functions, the needs of older people will be complex and changeable, and there may be a psychological state in which the needs of all levels coexist at the same time. It is urgent to consider an effective needs analysis model to solve this problem. Therefore, this paper uses MHNT to analyze, which has high applicability and accuracy. At the same time, in order to realize the social value of this study, that is, the integration of social pension resources and the optimization of social pension structure, we must clarify the relationship between government departments and pension organizations, and clarify the providers of pension services, which is in line with the inherent characteristics of WPT. Therefore, this study uses MHNT and WPT to prove the advancement and applicability of the "Internet +" enabled community pension model. In addition, use system dynamics to demonstrate its progressiveness

### 3.1 Maslow's Hierarchy of Needs Theory

The hierarchical needs theory was put forward by American psychologist Maslow in 1943 [14], which divides human needs from low to high into five levels: physiological needs, security needs, social needs, respect needs, and self realization needs. In MHNT, when the previous needs are met, people will start to pursue the next needs, and there is a ladder between the five needs (as shown in the figure).

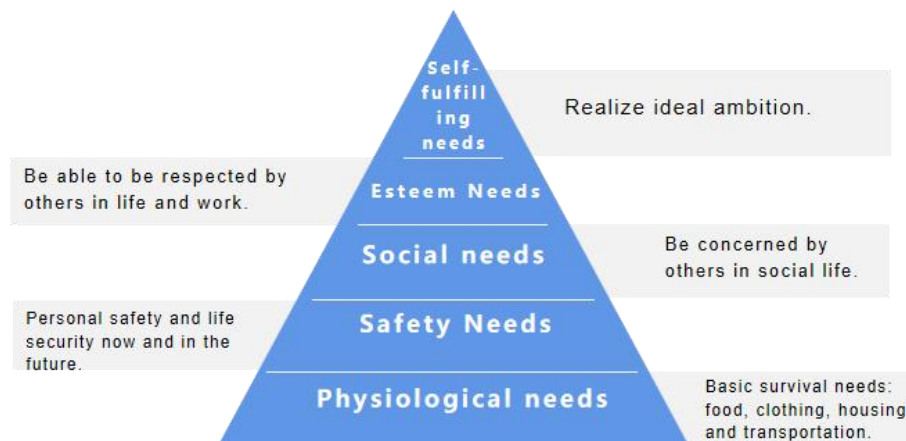


Figure 3 Maslow's hierarchical demand theory

### 3.2 Welfare Pluralism Theory

The WPT was mentioned in the future report of wolfender's voluntary organizations [15] in the UK in 1978. It means that the responsibility for social welfare should not be borne by the government alone, but by the public sector, profit-making and non-profit organizations, communities and families. For the division of welfare pluralism theory, different scholars have also put forward different opinions, among which the mainstream division methods are Ross' trisection and Johnson's quartering. The characteristics of rose[16]'s trisection and johnson[17]'s quartering are shown in the table.

Table 1 Classification of welfare pluralism theory

Classification	Proposer	Primary coverage	Application scenarios	Welfare providers
Trisection method	Rose	Variable welfare providers should play a combined role rather than a relationship of mutual substitution	Some countries and regions with immaturity NGO organizations	Country, family, market
Quartering method	Johnson	The four departments should interact with each other instead of being separated from each other	Countries and regions with well developed NGO organizations	State, family, market and other voluntary organizations

### 3.3 System Dynamics (SD model)

System Dynamics (SD) absorbs the essence of system theory, cybernetics and information theory. It is an interdisciplinary subject based on information feedback to analyze and solve problems. It is also a horizontal subject integrating natural science and social science. System dynamics uses the system modeling language dynamo to describe the computer simulation program model, and completes the effective regulation of the system by simulating the function, structure and dynamic behavior of the system. On the basis of the system dynamics model, it analyzes and studies the relationship between the system structure mechanism and the system dynamic behavior, so as to

provide scientific and necessary information for decision-makers. In the analysis of the community home-based care model, the supply-demand balance ratio of the four pension models of institutional care, community care, home care and balanced care will be analyzed by modeling, so as to provide decision-making. The basic formula is as follows:

(1) Equation of state variable:  $L \quad L.K=L.J+DT*(RA.JK-RS.JK)$

In the equation: L refers to the equation of state variable; L.K is the new state variable value calculated by the system at time K; L.J is the state variable value of the system at the previous time J; DT is the step size, that is, the length of the solution interval between time J and time K; RA.JK is the inflow flow rate of the system; RS.JK is the outflow flow rate of the system. When the step length is the infinite time for solving the interval DT, the state variable equation can be regarded as the operation of solving the integral. At this time, the state variable equation is correspondingly

$$L_0 + \int_0^t (RA - RS)dt$$

expressed as:  $L =$

(2) Rate variable equation: it is a function determined by state variables and parameter variables. Therefore, the rate variable equation can be expressed as

$$R \quad R.KL=f(L.K, C)$$

In the equation: R is the rate variable equation; R. KL represents the value of the rate variable at time k, f represents the functional relationship, L.K represents the value of the state variable at time K, and C represents the parameter variable.

(3) Auxiliary variable equation: it is a supplement to the rate variable equation. Generally, it has no fixed value and can be represented by "A".

In addition, a system dynamics model also includes constant equation, initial value equation, table function, source and sink, logistics and information flow, modeling and testing function and control statement.

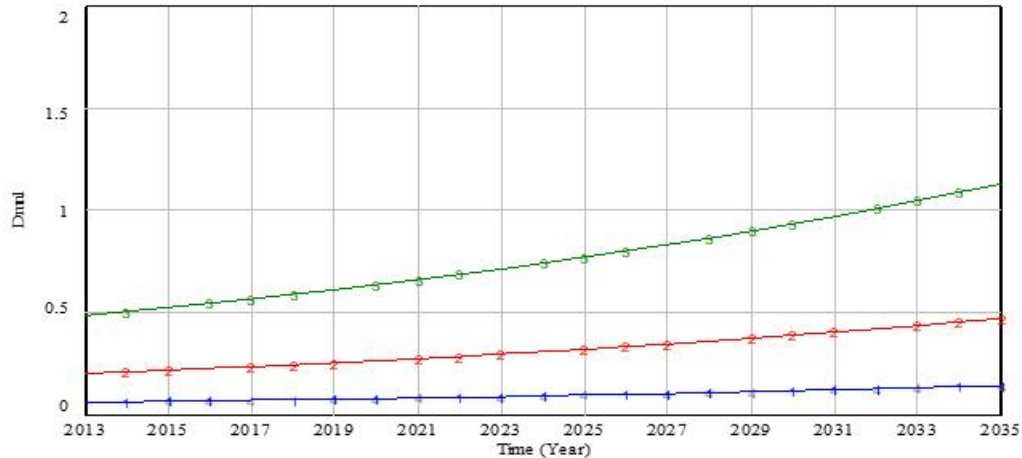
## 4. Case analysis

### 4.1 Analysis of home care model in China

According to the SD model, China's GDP and a series of data from 2006 to 2013 were modeled and fitted, and the following results were obtained. Compared with the actual value, the error was within 10%, indicating that the model fitting results were reliable and the model had strong practicability.

		GDP (units:billi on)	Population over 65 (unit: ten thousand)	Basic medical and health services (unit: ten thousand)	Number of personality in community service institutions (unit: ten people)	Total income from community appropriately care services (unit: ten thousand RMB)
2006	Actual value	209407	10419	9108	6681184	243040
	Estimate	209407	10419	8230.19	6681180	253180
	Error value (%)	0%	0%	9.64%	0%	-4.17%
2007	Actual value	265810	10636	21790	6964389	4012524
	Estimate	254608	10731.6	22507.1	7020490	3665520
	Error value (%)	4.40%	0.90%	-3.29%	0.81%	8.65%
2008	Actual value	314045	10956	25700	7251803	5453707
	Estimate	297166	11053.5	24636.2	7377030	4911410
	Error value (%)	5.68%	0.89%	4.14%	1.73%	9.94%
2009	Actual value	340903	11307	26080.2	7781448	4193903
	Estimate	318482	11385.1	28002.2	7751680	4020820
	Error value (%)	6.58%	0.69%	-7.37%	0.38%	4.13%
2010	Actual value	401513	11894	34740.4	8207502	5453707
	Estimate	383196	11726.7	31985.4	8145360	5910430
	Error value (%)	4.78%	1.41%	7.93%	0.76%	-8.37%
2011	Actual value	473104	12288	40050	8616040	6852920
	Estimate	455039	12078.5	36262.7	8559020	6826990
	Error value (%)	3.97%	1.70%	9.46%	0.66%	0.38%
2012	Actual value	519470	12714	44175.1	9115705	8146301
	Estimate	484371	12440.8	39834.1	8993700	7798330
	Error value (%)	6.76%	2.15%	9.83%	1.34%	4.27%
2013	Actual value	568845	13199	48651.5	9578652	9412635
	Estimate	557026	12814.1	43843.8	9450450	8845400
	Error value (%)	2.08%	2.92%	9.88%	1.34%	6.03%

According to the results of SD model analysis (as shown in the figure below), the supply-demand balance ratio of the four pension modes can be obtained. It can be seen that only the home-based pension mode can realize the supply-demand balance of pension service demand and community basic medical and health services, achieve the economic and social goals of the system operation, and realize the benign cycle of the system.



## 4.2 Analysis of home-based elderly care model in Meilin community

### 4.2.1 General situation of Meilin community in Dongzhi County, Anhui Province

Meilin community has a total resident population of 10167 people and 3291 households. However, due to the large number of young people in the county going out to work, many permanent residents in the community are older people. The survey interviewed 58 elderly people in Meilin community, with a total of 30 households. In the process of interview and research, we asked the community managers and the elderly in the community for their opinions on the current situation of home-based care in the community.

Table 2 Interview questions on home care in Meilin community

No	Interview questions
1	Is there any community home care related measures in the community at present?
2	Can the existing community home care model in the community meet the needs of residents?
3	How professional are the appropriately care service staff in the community?
4	Is there a perfect training system for appropriately care service personality in the community?
5	Does the community have emerging technologies such as Internet platforms to assist the elderly?
6	How is the Internet platform used in the community?
7	Is there a shortcut of funds in the current appropriately care service in the community?
8	What are the current funding sources of the community?

#### 4.2.2 Number and age distribution of elderly population in Meilin community

Through interviews and field visits with the main principals of Meilin community, and in combination with relevant documents within the community, we learned that there are 1803 healthy elderly people (over 60 years old) in the community, accounting for 17.7%, which shows that the elderly population in Meilin community accounts for a large proportion. There are 1210 elderly people aged 60-65, accounting for 67.11% of the total elderly population; 457 elderly people aged 65-80, accounting for 25.35% of the total elderly population; There are 136 elderly people over 80 years old, accounting for 7.54% of the elderly population.

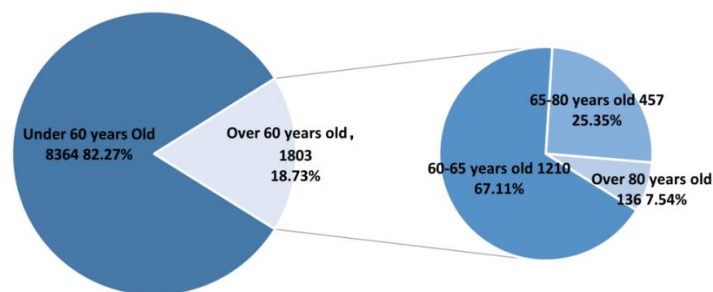


Figure 4 Number and age distribution of elderly population in Meilin community

#### 4.2.3 Analysis on problems of home-based elderly care mode in Meilin community

The aging situation in Meilin community is relatively serious. In order to meet the needs of the elderly in the community, the community has also continuously increased its investment in elderly care services and actively explored new ways of community home-based elderly care. At present, the community home-based elderly care services in Meilin community mainly include three measures: Medical care integration, building a "smart platform" and grid management.

However, according to the interview and survey results, we found that Meilin community had problems in the construction of community home-based elderly care model, such as the lack of full-time staff, difficulties in obtaining financial support and difficulties in using emerging technologies such as the Internet.

##### (1) Lack of full-time staff related to pension

At present, the elderly care service staff in Meilin community are mostly composed of the original community staff and volunteers. The original scope of work of the community staff did not

include services for the elderly. Many staff only work in the way of learning while doing after short-term training, and are also limited by their academic level and comprehensive quality. Some staff members rely entirely on their own experience and subjective ideas to provide services for the elderly, lacking the support of methodology and unable to meet the basic needs of the elderly.

#### (2) Difficulty in obtaining financial support

According to the interview, the pension service funds of Meilin community are all from the local government financial allocation, without investment from social capital, and the standard of pension service subsidies can not meet the construction of infrastructure, resulting in the following difficulties: (1) it is difficult to obtain external funds. Some facilities have been abandoned due to lack of funds and long-term lack of maintenance. (2) The financial support of the state is difficult. Water and electricity fees and other expenses of community elderly care facilities need financial support. Once there is a lack of financial support, the basic supply of water and electricity may not be guaranteed. In addition, it will also lead to the scarcity of talents.

#### (3) There are difficulties in the practical application of emerging information technologies such as the Internet

The concept of "Internet +" pension has been put forward for some time. However, although the managers of Meilin community pay attention to the application of this kind of technology subjectively, due to technical difficulties, they are not able to develop and apply emerging technologies well. According to the survey, the "home care service center" built by Meilin community at a cost of 200000 yuan has received good evaluation, but there are no professionals to carry out the follow-up platform maintenance work, and there are some problems in the research and development, resulting in the platform can not be well used.

There are also some difficulties in the use of the platform: (1) resource integration. The existing service platform in the community can not realize the complete information integration function. For example, the elderly can not describe their individual needs in detail on the platform, but can only choose from several basic functions given; At the same time, the data information on the platform can not be well shared, and the various departments in the community use the information in different ways and for different time, so that the information can not flow smoothly; (2) Nonstandard information. The platform seems to have a large amount of information, but in fact, due to the defects of the information management system, service personnel and the elderly can not find the information they need, and the platform does not have a mechanism for accurate information push, so it is difficult for the information platform to provide refined and timely services; (3) Imperfect laws and regulations. Such problems make it difficult for the elderly to ensure the security of some personal privacy issues involved in using the platform.

### 4.3 Countermeasures for the problems existing

#### 4.3.1 Improve the training mechanism of service personnel

Considering the external factors, the government departments should introduce the incentive system for the elderly care service personnel as soon as possible, and establish the normative standards for the employees in the society; From the inside of Meilin community, we can improve the quality of staff from the following points: (1) establish a training system for practitioners and continuously strengthen training to cultivate professional ethics and concepts; (2) Further improve the personnel system of combining professionals and volunteers, improve the information registration of volunteers' working hours and specialties, solve the problem of volunteers' time arrangement, and provide more targeted services for the elderly group, so as to meet the personalized needs of the elderly from different focuses; (3) Establish staff assessment standards and improve the reward and punishment system.

#### 4.3.2 Broaden access to funds and expand social participation

At present, the shortage of funds in Meilin community is mainly due to the single channel of obtaining funds, and the financial support obtained only from government departments is not enough to support the long-term service for the elderly. Therefore, the community needs to expand publicity efforts, actively encourage all social parties, such as enterprises and institutions, other pension institutions, to participate widely, provide financial support or free aid materials, and cooperate with enterprises, Provide high-end services such as physical examination, encourage eligible older people to purchase high-end services that meet their own needs at their own expense, and use the proceeds to provide basic services to more groups in need free of charge, so as to solve the problem of funds.

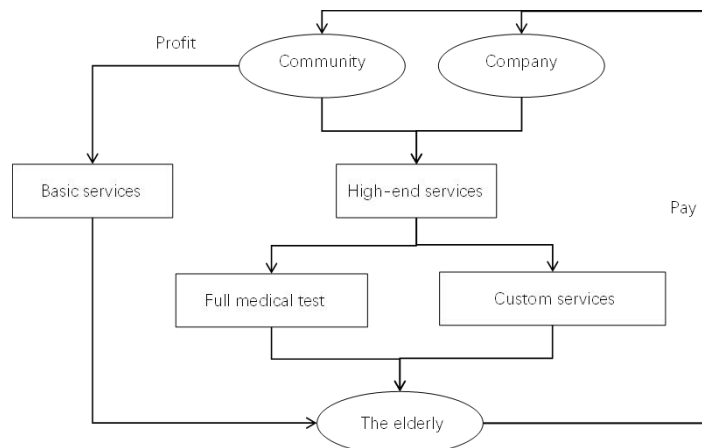


Figure 5 Innovative pension service mode

#### 4.3.3 Improve the effectiveness of technology application and improve system construction

There are many difficulties in the development of information service platform relying solely on the ability of the community. Therefore, the community can take the form of cooperation or employment, take advantage of the information technology advantages of foreign units, such as the information platform connected to the hospital and other platforms, make full use of the intelligent endowment advantage of "Internet +", effectively integrate information resources, provide diversified and accurate services, and improve service efficiency.

In terms of system construction, the community should do the following two parts: (1) establish and improve service quality evaluation standards, and strengthen the supervision and management of community home-based care. (2) Accelerate the construction and maintenance of infrastructure service facilities, and speed up the renewal of old and abandoned facilities and equipment in combination with the cooperation with enterprises, institutions and institutions.

## 5. Summary

In the process of aging in China, the existing social pension models, such as family pension and institutional pension, can no longer meet the growing personalized and diversified needs of the elderly. Under this background, the traditional institutional pension model can no longer meet the needs.

At the same time, it is also a burden for families and society, so there is a demand for a new pension model in society. After consulting and sorting out the relevant literature, this paper summarizes the definition, demand analysis, the application of pension technology and the problems existing in the domestic community pension model of scholars at home and abroad, which provides a reference for this paper to put forward views on community home pension. At the same time, this paper uses Maslow's Hierarchical Needs Theory and welfare pluralism theory to study the various aspects involved in community pension, such as the needs of different elderly groups and the welfare providers of community pension. Finally, the model established by system dynamics is

used to demonstrate that the community home-based elderly care model has more advantages than other elderly care models.

Taking Meilin community as an example, through three interviews and a survey of 58 people, it can be seen that although the community has started the construction of Intelligent Community pension mode and achieved some results, we can find that there are still problems in the construction of Intelligent Community pension mode in Meilin community, such as lack of full-time staff, difficulty in using new technologies and difficulty in obtaining funds. Combined with the literature survey and the research methods of this paper, we give three coping strategies, which are: (1) improve the training mechanism of service personnel and improve the quality of personnel; (2) Broaden access to funds and expand social participation; (3) Improve the effectiveness of technology application and improve the system construction. This paper hopes to provide reference for the construction of smart community home care model in China through the analysis and Countermeasures of Meilin community.

Although the research and practice of the home-based elderly care model in smart communities are not yet mature, it will be of great significance for the improvement of the quality of life and social governance of the elderly nationwide and globally.

## References

- [1] Health and Health Commission Statistical bulletin of health development in China in 2021, 2022
- [2] National Bureau of statistics. China's fifth census data in 2000, 2000
- [3] Feng Qi. Community care in Britain and Its Enlightenment. Northwest Population, 2010,31 (06): 20-24 + 28. Doi:10.15884/j.cnki.issn.1007-0672.2010.06.008.
- [4] Parrott, L. (2001) Social work and social care (2nd ed.). Routledge <https://doi.org/10.4324/9780203165614>.
- [5] Du plan C g. Dependency et solidarité é s: mieux aider les personnes Ag é es: rapport de la Commission Presid é e par Pierre schoplin[j] Commissariat Gen é ral Du plan: Paris, 1991.
- [6] Sharkey P. Essentials of community care[m] Bloomsbury Publishing, 2017.
- [7] Guangzong Mu. Challenges faced by family pension and social countermeasures. Zhongzhou Journal, 1999 (01): 64-67.
- [8] Fen Shu. From family support to social support: the change of rural support for the elderly in 70 years of new China. Zhejiang Social Sciences, 2019 (06): 83-91 + 157-158. doi:10.14167/j.zjss.2019.06.009.
- [9] Bock o, Engelhard K, guardiera P, et al. Gerontechnology and human cognition[j] IEEE Engineering in Medicine and Biology Magazine, 2008, 27 (4): 23-28.
- [10] Kearns w. Gerontechnology: is it time for regulation[j] Gerontechnology, 2017, 16 (2): 63-64.
- [11] Xiao Yu, Yue Sun. "Internet + pension": Research on the innovation and development of pension service mode in the new era. Journal of Population, 2017,39 (01): 58-66. doi:10.16405/j.cnki.1004-129x.2017.01.006.
- [12] Lili Wang. Research on the demand, supply and utilization of home care services based on the "service chain" theory. Population Journal, 2013,35 (02): 49-59.
- [13] Quansheng Liu, Xiaowei Han. Analysis on the main problems and Countermeasures of smart pension in China. Chinese and Foreign Entrepreneurs, 2019 (30): 235.
- [14] Jing Chen. Application of Maslow's hierarchy of needs theory. China Cement, 2019 (06): 58-62.
- [15] Wolfenden J. The future of voluntary organizations: report of the Wolfenden committee[m]. Taylor & Francis, 1978.
- [16] Rose R. Common goals but different roles: the state's contribution[j]. The Welfare State East and West, 1986: 13.
- [17] Johnson N. Mixed economies welfare Routledge, 2014.