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Construction for the Smart Old-age Care in an Age of Longevity: A Literature Review

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Abstract. The deepening of the aging population has increased the pressure on social security and public services, affected social vitality, innovation power, and potential economic growth rate. Fortunately, with the development of science, the "Smart City" is also being built, so how to utilize intelligent technology to deal with the aging issue is a worthy orientation. This literature review integrates the aging status quo and countermeasures in typical countries, analyzes the current problems of Smart Old-age Care system in various aspects, and proposes phased recommendations (Smart C&A homes, Smart Home, Smart Community, Smart City) according to different aging degrees, thereby offering new ideas and directions for the Longevity related topics in the future.

1. Introduction

According to the United Nations definition, the elderly are those who reach or exceed the age of 65. Moreover, by 2019, the global population aged 65 or over is 703 million; it is expected that by 2050, the number of elderly people will double to 1.5 billion [1, 2]. And based on the prolongation of life span, it is a high probability event for our generation to live to 100-years old. Nonetheless, the three-stage life of "reading-working-providing for the aged" has gradually died out and replaced by a "multi-stage" life, which is the basic prototype of a Longevity life [3].

With the increasing demand for value re-creation, the updating of relevant policies and social models of provision for the elderly is becoming increasingly urgent in the process of Smart City construction. Fortunately, Smart Old-age Care platform provides a new way and solution, which "provides convenient and timely diversified elderly care services using various modern technological means" [4]. Thereby, the construction planning of Smart City for reducing the burden of social, medical care, and creating a comfortable environment for the elderly under the background of longevity is quite considerable [5].

Nevertheless, from the world perspective, it still lacks a relatively unified and sound construction system. Therefore, this literature review analyzes the current status quo and countermeasures of aging in typical countries, summarizes the possible problems in various aspects (e.g., development of society, urban zoning, community services, facility management, medical health, work policy, and innovation-driven), and puts forward staged suggestions according to different degrees of aging, which could provide a more definite direction and a preliminary planning reference for future researches.

There are other six sections consisting of this literature review: the status quo of Aging and Smart Old-age Care, the existing problems, recommendations, conclusion, acknowledge, and references.



2. The status quo of Aging and Smart Old-age Care

2.1. Aging situation and countermeasures in typical countries

From the World Population Data Sheet 2020, the elderly number is rising rapidly [6], and the specific countermeasures of different countries are diverse, which can be concluded as Table 1.

Table 1. Aging status quo and countermeasures in some typical countries

| Country | age ≥ 65 | Primary Type | Pension source | Countermeasures |
|--------------|-------------|---------------------------|--|--|
| Japan | 28% | Cohabitation ¹ | National Pension Enterprise | Elderly Welfare Act National Pension Law Promote "Ten years of Free Medical Care" |
| | | | Personal plan | Elderly Health Act Nursing Care Insurance Act Nursing Care Insurance System |
| UN | 18% | Independent ² | National basic pension Enterprise | Poverty Alleviation Law National Subsidy Law Standard of Care |
| | | | National second Pension Social security tax Enterprise | Social Security Law Social Welfare Act Social Service Plan |
| US | 16% | Independent | Personal plan | OBRA Act Old Man Act |
| | | | National | Basic Old Age Annuity National Pension & Special Occupational Pension Enterprise Personal plan |
| Korea | 15% | Cohabitation | National Pension Law Employee Retirement Income Security Act Old Age Long-Term Care Insurance Law Nursing Care Insurance System | |
| | | | Personal plan | Health Care Integration Policy Pension Insurance Policy Smart Pension Policy Fiscal Subsidy Policy |
| China | 12% | Cohabitation | National basic pension Enterprise | |
| | | | Personal plan | |

1: The elderly prefer to live with their children; 2: The elderly prefer to live alone or in corresponding institutions.

2.2. Development status of Smart old-age Care

Above all, according to the development situations of Smart Old-age Care throughout the world, there are mainly three kinds of elderly modes could be summarized in Table 2.

Table 2. The modes and features of Smart Old-age Care

| Mode | Features |
|-------------------|---|
| Smart Institution | Care and Attention homes (C&A) |
| | Nursing homes |
| | Geracomium |
| Smart Home | Independent type |
| | Service type |
| | Medical type |
| Smart Community | More considerable scale and sound service |

With the gradual broadening of the research field, information technology has been harnessed mainly from the aspects of improving remote care, telemedicine, intelligent auxiliary equipment and health data monitoring [7]. For example, Hussain et al. designs a health emergency service platform based on the medical service needs of the disabled elderly, which can provide timely medical services for the disabled elderly [8]. "Smart Medical" in Hangzhou, China, provides free physical data monitoring, remote consultation, remote health examination, first-aid positioning and other services for the elderly [9]. Fahim et al. establishes a smart platform by using the Internet of things, big data, cloud computing, mobile devices [10]. Alaoui et al. develops an environment assisted elderly living platform with the help of television, through which they can seek services [11]. In addition, the social interaction of the elderly should not be ignored, Bothorel et al. proposed an intelligent elderly care network platform based on social services, hoping to help the elderly overcome loneliness [12].

Simultaneously, there are also various robots utilized to help the elderly [13], such as Companion robots, Manipulator service robots, Rehabilitation robots, Health-monitoring robots, Reminder robots, and Entertainment robots, etc.

3. The existing problems of Smart City in the age of Longevity

3.1. Development of Society

Social problems in the field of Old-age Care mainly exist in developing countries, and the most common is the "Getting Old before Getting Rich" phenomenon [15, 16]. To be specific, when the economic capacity, system construction, and ideology are not well prepared, an aging society has been ushered in. Under this condition, the relevant employment of the elderly and various supporting policies and services are not perfect, and the elderly are also difficult to obtain a good guarantee in social status and social services.

Moreover, in the process of realizing the social care modes, some problems also arise, mainly including: (i) There is still a big difference in the provision of social pension services between urban and rural areas [17, 18, 19]; (ii) Current elder care services are still biased towards the material and ignore the spiritual and psychological pursuit of the elderly [20, 21, 22, 23]; (iii) The majority of social care service personnel have not received professional training, whose quality is generally low and unscientific [23]. (iv) In addition, some social policies in early phase, traditions, and ethics may bring challenges as well, such as the one-child policy [24], virtue of supporting parents etc. [26, 27], which are likely to stimulate some additional contradictions.

3.2. Urban Zoning

Above all, through the study of the spatial distribution of aging in Russia, Canada, and other countries, the elderly population is mainly concentrated in the core area of the city and some remote rural settlements, and there is also a tendency to expand to suburban areas [28, 29, 30]. However, the residential-type on the edge of urban areas is often complex: there are not only valuable high-end buildings, but also more migrant workers' concentrated rental areas [30]. And this living circumstance make the elderly isolated and marginalized, so that the elderly Quality of Life (QoL) cannot be improved,

which poses a severe challenge to the allocation of urban spatial resources and the development of urban space [32, 26].

In addition, different cultural levels and value orientations will form different groups of the elderly [33, 34], and the same type of elderly living together constitutes a community, which leads to the internal differentiation of the living space of the old people. Therefore, in the process of Smart City construction, the use of static population spatial distribution models to design land, public transportation, and supporting facilities will result in the distribution of the elderly do not match the development of urban spatial elements.

3.3. *Community Services*

The service construction of the Smart Community still needs to be improved. For instance, (i) Lacking service professionals and sufficient funds to support services [35, 36, 37]; (ii) The scarce of uniform design criteria for the Smart Community service platform, resulting in poor user experience and unbalance between supply and demand [38] ; (iii) The group service of the community does not fully consider the individual differences and consumption habits of the elderly, thereby reducing the pertinence and effectiveness of services [37] [38]; (iv) The information exchange between the government, enterprises and social organizations is not circulating, leading to the loss of massive elderly data [39].

3.4. *Facility Management*

The elderly associated Facility Management (FM) factors can be basically divided into three aspects: Architectural characteristics (space planning, privacy, decoration colors, furniture, etc.), Building Services (lighting, ventilation, fire, water, temperature, noise, safety, lift system, etc.), and Supporting Facilities (sanitation, entertainment, catering, non-slip flooring, doors& windows, signage, etc.) [36, 37, 38]. There were also many studies finding that FM could affect the elderly QoL (physical, psychological, social, environmental, and independence), such as space planning, distance, ventilation, temperature, lighting, color, furniture, non-slip flooring, handrails, barrier-free facilities, and recreation facilities, etc. [39,40, 41, 47, 48], especially for the aged with dementia [48].

Nevertheless, due to the untimely change of concepts, there are still some apparent shortcomings of FM in C&A homes and private buildings. For example, (i) There are only survival facilities, but lacking of entertainment, and spiritual construction [48, 49]; (ii) The elderly related criterions are not be utilized during designing [51]; (iii) It is market-oriented and profitable, without really considering the elderly demands; (iv) The shortage of the assistance of intelligent systems [52]. (v) In addition, the scarce of beds in C&A homes is also a problem to be solved [54, 55].

3.5. *Medical Health*

The development of medical technology not only prolongs the life span of human beings but also brings more medical burden, especially the Non-communicable Chronic Diseases (NCD) [55]. Moreover, the shortage of the labor force and nursing professionals [56], and the high cost of care [57] undoubtedly make the problem more serious.

Therefore, as reducing the treatment cost through prevention and bringing health security, the "combination of medical and health care" has become the mainstream of the construction of old-age care modes. However, due to the immaturity of the system, some aspects need to be improved as well. For instance, (i) The responsibilities of departments are not clear, leading to unclear boundaries of medical care and support, and opaque fund allocation [58] [59]; (ii) The discordant arrangement of nursing and medical beds results in the waste or shortage of treatment resources [61]; (iii) The slow return of funds causes the lack of action power of enterprises and hospitals [61]; (iv) There is still a gap of the level and status between nursing and medical staff, which gives rise to the low intention of personnel and lack of professional talents [63, 64, 65].

3.6. Work Policy

Actually, the knowledge and experience of the elderly are both precious societal wealth, so improving the employment rate of old adults reasonably can realize the value-recreation of human resources [64]. Nonetheless, although some countries (e.g., South Korea and Japan) [66, 67, 68] have implemented policies related to the elderly work, there are still biases and misunderstandings concerning the elderly employment among government and enterprises in the majority of countries: (i) The government's inadequate security policy for the work of the elderly [69, 70], causing the worry of elderly labor rights; (ii) The value of elderly experience has not been fully recognized among society; (iii) The acceptance of older workers by enterprises is still generally partial low; (iv) The family attitudes, conditions of the elderly themselves, and the opinions of friends can affect choices as well [70].

3.7. Innovation driven

With the increasing demands for elderly services, it is an inevitable trend to explore the new modes in order to keep up with the progress of Smart City. However, due to the rapid aging, the innovation of the Old-age Care modes is usually not supported by the corresponding technology [71].

(i) The main obstacle is the backwardness of the Internet of Things information collection technology [72]. In essence, the intelligent terminal equipment is too simple to obtain detection of the elderly fall and other abnormal situations accurately, thereby affecting the follow-up service; (ii) Moreover, the equipment quality is poor, and there is no systematic and convenient after-sales service, so once damaged, it is difficult to complete the continuous data collection and feedback; (iii) The collected information cannot be used to realize the docking with the service, so that it is challenging to meet the needs of consumers. (iv) Cloud technology, multimedia technology, and other related technologies are relatively backward, leading to weak visualization effect, which is not conducive to the operation and understanding of the elderly.

4. Recommendations of Smart City construction in the age of longevity

Firstly, according to different aging degree, the social security can be divided into three stages, corresponding to different modes and support subjects in the Table 3.

Table 3. The development of Elderly Modes with Aging degree

| Stage | 1: Early stage of aging | 2: Middle stage of aging | 3: Increasing aging |
|-----------------|---------------------------------------|--------------------------|---------------------|
| Mode | Traditional Institutions or Home Care | Elderly Apartments | Elderly Community |
| Subject | Government | Government+ Developers | Developer-oriented |
| Social Security | Low-level | Some Government Support | Perfect System |

Secondly, although the elderly related industry is blossoming, there are still some obvious problems. Therefore, the market cannot be expanded blindly, and there should be a relatively sound planning reference for the construction of Smart Old-age Care construction. Starting from demands, and based on the characteristics of the contemporary elderly, four aspects could be summarized.

Table 4. The elderly demands of construction for Smart Old-age Care platforms

| Demand aspects | Specific requirements |
|--------------------------------|--|
| Life Service | Nanny needs Living needs Dietary needs |
| Health Management | Health assessment Intervention guidance Health care |
| Safe Care | Health monitoring Emergency needs Safety monitoring requirements |
| Spiritual Entertainment | Communication needs Entertainment needs Learning needs |

Moreover, the smart platforms also have some specific requirements under different modes, so there are the respective conclusions below.

4.1. Smart C&A homes

The chief operating body of Smart C & A homes can be the government, private institutions, or medical institutions. To be specific, (i) In terms of health management, the combination of medical and health care should be promoted [73], and the regular physical examination, health assessment, and health recordings ought to be carried out; (ii) In terms of safety emergency, there should be intelligent monitoring care [74], call system, etc. to ensure elderly safety; (iii) In the aspect of information management, the dynamic information system between C&A homes and the government should be established, recording the elderly health conditions, test data, medical staff information, etc., so as to share and utilize the data resources; (iv) In terms of spiritual entertainment, C&A homes can cooperate with the elderly universities, hold activities such as interest training, spiritual consolation, helping and pairing, festival celebration, family care, etc., or introduce suitable low-intensity work for the elderly.

4.2. Smart Home

The "independent" elderly live alone in the apartments, who usually lack caring. Therefore, the Smart Home system is essential, and which is also necessary to consider for the new Old-age Care real estate projects.

For example, (i) In terms of life services [75], there should be home-care calling, commodity purchasing, and other services; (ii) In terms of health management [76], the health service network, intelligent application software, family follow-up, family doctor mode, and on-site services are supposed to be promoted for the elderly at home; (iii) In terms of safety care [77], emergency calling, real-time positioning, action monitoring, electronic fence, safety warning, convenient alarm system, etc. are needed to ensure the elderly safety; (iv) In terms of spiritual entertainment [78], the residential quarters should be equipped with a gymnasium, chess and card rooms and other entertainment areas, and the owners' committee should be encouraged to carry out regular activities in the residential area, such as Festival Entertainment parties.

4.3. Smart Community

Smart Community is the basic component unit of Smart City [79], so a comprehensive cloud data platform should be established. (i) The medical service center is cardinal [80], such as a small clinic, psychological counseling center. Besides, the community health service network should be built to record the health status of the elderly in real-time so as to find abnormalities in time; (ii) Establishing a life service center [81], such as the elderly canteen (according to the elderly dietary guidelines), the

elderly daycare center, and the online commodity supply chains; (iii) A cultural activity center is also needed [82], including chess and card rooms, gyms, drama and dance interest classes, cinemas, etc.

4.4. Smart City

To build a suitable Smart City for the elderly, it is necessary for the convenient life and traffic-flow reduction to divide functional areas and set up facilities by walking.

Therefore, the planning should follow the "Based on the Elderly" principle: (i) Building a "slow traffic system" [82]; (ii) Strengthening the design of barrier-free passage [82]; (iii) Reasonably allocating public facilities according to the distribution of elderly groups; (iv) Fully saving and utilizing medical resources in combination with rehabilitation hospitals and high-level hospitals [83]; (v) Integrating elderly residential areas, children's work areas, and kindergartens, etc., in order to form a multi-generation livable city with multi-functions [84].

5. Conclusion

To sum up, the Smart Old-age Care Construction is a complex project. Nevertheless, no matter which mode, the system ought to realize information exchange, resource complementation and full coverage of service network, then form a sizeable smart platform for resource sharing, thereby achieving the ultimate objective of diversification, and providing a vast real-time information database for Public Hygiene.

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