The development of smart eldercare in China

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Summary

Background Many countries have tried to establish an optimal model for managing population aging that can be replicated and promoted. With the increasing societal task of delivering care to older adults with chronic conditions, China has started to harness the power of digital technologies to help address the growing demands for eldercare. China is exploring a unique "Smart Eldercare" model to respond to the social service needs of older adults.

Methods Using a Delphi method, this study highlights a hierachy of approaches and findings from a cognitive support tool for those with mild cognitive impairment.

Findings From the central committee to local governments, the Chinese government has developed policies aimed at supporting the development of the Smart Eldercare service industry.

Interpretation This viewpoint article sheds light on this development in health care services based on an onsite research investigation, which can potentially impact the Western Pacific region and beyond in years to come.

Keywords: Smart eldercare; Healthy ageing; China

Introduction

Population aging and rapid technological development are defining features of the last few decades of humanity. We have demonstrated a richer imagination and higher efficiency in this era, but we also face extraordinary challenges in adapting to the changing world. New digital approaches have created opportunities to serve older adults, which has the potential to improve happiness, sense of worth, and security, as well as potentially relieve a lot of labour and stress for young and middle-aged people. However, not everyone is willing to participate in the digital society. Thus, finding pathways to effectively use digital technology to improve quality of life has become an important issue. This paper discusses the current development of Smart Eldercare, the digital divide, and reflections on digital services for older adults.

Smart eldercare utility and its development in China

The rapid development and expansion of digital technologies profoundly impact social life. Long distances no longer hinder access to medical care, many falls can be predicted or discovered immediately, and robotic companions can address loneliness and isolation. In 2003, Chinese scholars began to study how to develop and implement intelligent and smart eldercare.[1] In recent years, under the guidance of national policies, digital technology has been closely integrated with the eldercare service industry, which has expanded the level of care services and become a new source of economic growth. Digital technologies are transforming eldercare in China into Smart Eldercare by promising cost-effective, scalable, and less human-depended solutions to address the needs of the fast-expanding aging population. Smart Eldercare in China, despite its enormous potential, exciting exposure, and favorable perceptions among the elderly, is still in its early phases with the following characteristics.

First, led by the government and driven by the policies, the Chinese government has attached great importance to the development of Smart Eldercare, and a series of policies have been put forward to support it from the central

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government down to the city municipal government. These policy measures certainly increased the public's awareness of Smart Eldercare and got people including older individuals thinking about aging in a new way.

Second, priority on growing Smart Eldercare into a new industry. This priority is demonstrated by consecutively issuing the Action Plan for the Development of Smart Health and Eldercare Industry covering 2017−2020 and 2021−2025 respectively. From a strategic standpoint, this policy design has undoubtedly lured many small and medium-sized enterprises into the eldercare domain; otherwise, they would not have done so. On the other hand, the majority of these new entrants are primarily economically motivated, and their activities might have a detrimental influence on the organic development of Smart Eldercare.

Third, pressure to take short-term measures in place of fully testing for long-term solutions. Unlike many other fields that have been transformed by digital technologies over the years, eldercare requires a great deal of patience. The ambitious policy direction from the top levels of government agencies put a lot of stress on local governments to implement innovative Smart Eldercre solutions in a relatively short time frame without carefully evaluating their readiness, often resulting in undesired outcomes that impeded the healthy growth of the Smart Eldercare.

The policy environment of smart eldercare in China
In 2017, the Ministry of Industry and Information Technology, the Ministry of Civil Affairs, and the National Health and Family Planning Commission jointly issued the Action Plan for the Development of Smart Health and Eldercare Industry (2017−2020). This action plan was China's first comprehensive and specialized national policy on smart eldercare. It provided a clear development direction for the Smart Eldercare industry and outlined a series of measures to support the development of Smart Eldercare. One of the primary features of this policy is its focus on healthy aging, and another is the objective of developing an industry around Smart Eldercare, advocated by its leading author: the Ministry of Industry and Information Technology.

In 2021, the Ministry of Industry and Information Technology, the Ministry of Civil Affairs, and the National Health Commission jointly renewed this policy push and issued the Action Plan for the Development of Smart Health and Eldercare Industry (2021−2025).[2] The Chinese government will continue to place a great value on the Smart Eldercare sector's growth, testing new technologies and models of service integration as evidenced by this continuous policy.

Smart eldercare service platforms
A smart eldercare service platform is the comprehensive use of sensor equipment, global positioning system, the internet of things, cloud computing, mobile devices, and other technical means to collect and process relevant information and provide services to older adults. For example, this information can involve the needs and health status of older adults, medical service resources in medical institutions, older adults' care service information in nursing homes, community volunteer service information, and professional and technical support resources such as family doctors. Using such platforms can reduce relevant communication and transaction costs and realize functions such as life care, safety monitoring, chronic disease management, route navigation, and digital payment.[3,4] Smart Eldercare platforms are commonly used in nursing homes, with institutional customization or the software as a service model as the solution. The advantage of this type of platform is that the collection of older adult-related information and service delivery can break through the limitations of geographic space, which means that older adults who are not in professional nursing homes can also enjoy efficient and professional care services. This is usually termed "Internet plus home-based and community-based care" or the "virtual nursing home." Home-based care is the preferred choice of many oldest-old adults both at present and in the future. Moreover, smart eldercare service platforms have great potential to match supply-and-demand better and realize personalized services accurately. They hold broad promise to reduce pressure on children and improve the quality of life of older adults.

Implementing smart eldercare platforms can bring to light the limitations of the technology itself and the disconnect of the interface with the user's daily routines.[5] or explore the use of technology to supplement caregiving in Singapore and found the limits of an engineered approach that lacks the human element. They found that many have unrealistic expectations of technology substituting for human centric care and collected their own human-centred analysis of how smart technologies are actually integrated into their lives. As a real world test of concepts normally studied in laboratories, they were able to demonstrate the importance of addressing user agency and apathy in adopting eldercare platforms in a society that bears some resemblance to China.

Innovative use of smart eldercare application scenarios
Several cities in China have established a requirements list of Smart Eldercare application scenarios as a policy instrument to guide the development of Smart Eldercare, and Shanghai led the way and released the first requirements list in April 2020.[6] The Delphi method was used to conduct the research. Our team interviewed social workers serving community-dwelling older adults and representatives of the Civil Affairs Bureau, the aging industrial association, and grassroots organizations that provide
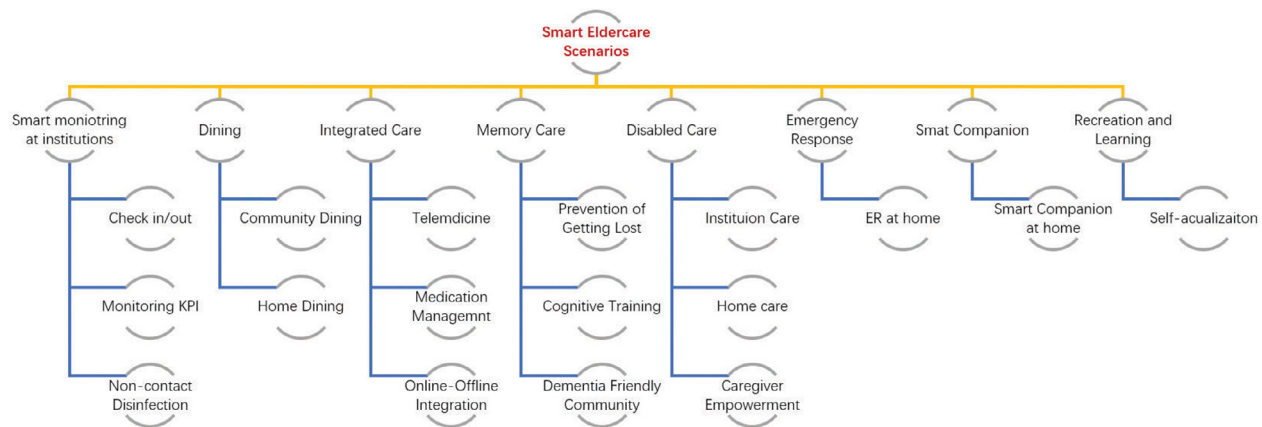
Figure 1. A hierarchy of smart eldercare scenarios.

eldercare services. The research team began with seventeen possible scenario cases. To examine scenario cases and evaluate them in terms of development stage, acceptance, and availability, our team employed in-depth interviews and participant observation. As shown in Figure 1, our preliminary research grouped seventeen use cases into eight categories: Smart Monitoring at Institutions, Dining, Integrated Care, Memory Care, Disabled Care, Emergency Response, Recreation and Learning, and Smart Companion.

Next, we focused on the Cognitive Training scenario of the Memory Care category to illustrate how this scenario is connected to the national and local policy, the socioeconomic context in Shanghai, and related digital technology development. This sceanrio was later adopted by the second requirements list of Smart Eldercare application scenarios released by Shanghai government in 2021.[7]

Case: cognitive training scenario for the older individual with cognitive impairment

Background
According to a recent national cross-sectional study, China has 15.07 million people aged 60 years and older with dementia, including 9.83 million with Alzheimer's disease, 3.92 million with vascular dementia and 1.32 million with other forms of dementia. In addition, the prevalence of mild cognitive impairment in those over 60 years old is 15.5%, with 38.77 million individuals affected by it.[8] Dementia poses significant physical and psychological challenges for individuals living with the disease, and creates the need for intensive caregiving and companionship care. The need for 24-h companionship and care places a heavy burden on family members and society. An evidence-based approach that can lead to early detection and intervention could have a dramatic effect on society.

The most common symptom of cognitive impairment in older adults is the decline of multiple functions including memory, attention, listening, speaking, and executive function. Effective cognitive training could enable selective optimization with compensation[9] as well tap existing cognitive reserve[10] to slow down cognitive deterioration in older adults. Digital technologies can support training and intervention for older individuals with cognitive impairment at home or in institutional care. Scientific guidance and training suggestions are available through digital technologies for family members and caregivers.

Policy environment
In 2016, China's Central Committee approved the Healthy China 2030 plan. The healthy aging section of the plan emphasizes the need to strengthen effective interventions for older individuals with cognitive impairment. In 2019, the "Shanghai Implementation Plan for Eldercare Services (2019−2022)" listed strengthening the care services for the cognitively impaired elderlies as one of the main tasks. In September 2019, 2020, and 2021, Shanghai consecutively rolled out new programs to create a supportive community serving 28, 50, and 44 residential communities respectively as its first batch, second batch, and third batch pilots of the Friendly Community for Older People with Cognitive Impairment.

Preliminary research
Early digital cognitive training products in China included brain exercise games and digital puzzles. Merilampi and colleagues[11] studied cognitive mobile games for older adults in a Chinese institutional care facility. Their most noteworthy finding was that games were viewed as a positive experience by participants and were viewed as cognitively stimulating. Despite such promising findings, there are few digital cognitive training tools in the Chinese market, and their capabilities are

rudimentary. First of all, their training effects are yet to go through more rigorous scientific evaluation. Secondly, these tools mainly aimed to help older individuals with mild cognitive impairment and did not address the need of older individuals with moderate and severe conditions. Finally, their application scenarios are narrowly focused to hospitals, psychological counseling institutions, and specialized experience centers, seriously restricting user accessibility. Professional mobile-based products based on empirical data for home use remain to be developed.

Needs analysis

The dissucssion with experts revealed the need for cognitive stimulation for older adults living in the community. In order for any intervention to be effective, the content of the cognitive training and the delivery methods should be evidence-based in scientific research to maximize its efficacy. Further consideration of the real-world implementation of such a program must cater to diverse application scenarios and modes. Such an application could be flexibly switched according to the needs of users in different scenarios including individual homes to have daily auxiliary training with the support of family members and centralized places such as eldercare institutions and community eldercare center.

The product design should also consider the user's physical and cognitive abilities, as well as their living environment. The timing of the intervention and the amount of time spent doing specific tasks can be fine tuned to fit the needs of the participants and impact their capabilities. The implementation should be simple and easy to follow, supplemented by user manuals and other methods to help older individuals with cognitive impairment and their caregivers learn and use these digital products. There should be a priority on ensuring that older people with cognitive training are kept engaged at a level that provides a modest challenge and that they adhere to apply it by providing mutual support and supervision through the use of innovative mobile applications.

Digital cognitive training products should have the ability to monitor and evaluate user performance. The results of monitoring and evaluation can guide personalized training, intervene when there are signs of regression, and provide data support for further scientific research.

Here we can also consider from a critical perspective the challenge of implementing a cognitive intervention program without direct supervision of those familiar with its implemention. There is an inherent assumption that the user understands the interface, will cooperate with instructions, and that most users will respond in a homogenized way as expected from laboratory testing of the application. There is the potential, particularly among those with cognitive impairment, that the guidance may not be followed closely. Here the context of China plays a unique role and may differ from studies in other nations where older people feel that compliance with official instructions of professionals and governement officials should be done without question. This could impact both acceptance and cooperation of study protocol, as well as affect the post-test results of any study in which participants might feel a need to demonstrate their compliance with the protocols.

Future directions

Digital cognitive training tools that are entertaining and engaging, yet scientifically validated, are needed to support the growing number of older adults with cognitive impairment in China. The inclusion of this application scenario in the city's 2021 requirements list of Smart Eldercare application scenarios indicated that the Shanghai government saw a clear need in the marketplace, but digital cognitive training products are still in their infancy in China. This scenario urged researchers to study advanced digital technologies. It also served as a call for high-tech firms to develop suitable digital products to fulfill this unmet need.

Barriers to adoption

Although the application of advanced technology is expected to lead to better outcomes, acceptance and use among older adults can be limited and even cause "digital anxiety." Moreover, product prices remain high, limiting the purchase and adoption of Smart Eldercare products. This mismatch between supply and demand has led to a phenomenon in the industry of "applause but no customers." There is clearly a need for services, but those services need to be designed with the end needs and abilities of the users in mind. Many applications and devices depend on the user to have high self-efficacy for technology or utilize health knowledge. Generational and socioeconomic differences lead to digital barriers that limit access for some. Technology or services can be used to help older adults live with more dignity.[12]

Changes in the need for senior care services

With economic growth, there has been a shift from family-centric support to professional and high-tech solutions that enable older adults to live alone longer. In addition to basic life needs, they have specific support needs that the digital service industry can address accordingly. Four primary factors will affect the future of smart eldercare services: (a) Price, given that some expensive technologies and services do not match the purchasing power of older adults[13]; (b) Perceived user-friendly features or operational difficulties that might prompt older adults to decline to use the technology[14]; (c) Self-efficacy, or confidence in being able to use intelligent technology smoothly[15]; and (d) Expected benefits, because if they are unable to

imagine the possible advantages of technology, older adults are less likely to use a service.[16]

The application of digital technology to support older adults' care in China has tremendous untapped potential. According to data from the China Longitudinal Aging Social Survey in 2016, 16% of older adults have a smartphone and less than 10% of older adults actually use a smartphone among more than 11,000 older adults in this database.[17]

Digital divide for older adults

The term "digital divide" originated from Toffler's description of the gap in the application of information technology between developed and developing countries in the process of globalization.[18] The digital divide also represents the information utilization gap among people, industries, and enterprises, reflecting a new inequality in the digital age.[18] In a digital society, information is an important source of power. Some social groups have a high degree of integration in the digital society, whereas others have a low degree of integration. The essence of this is the inequality of knowledge and power among different social groups. Unequal access to public networks and public data can exacerbate digital segregation. Qiu[19] pointed out that the level of digital development is not only determined by the appearance of technology but by social regulation. In an aging society, digital inequality mainly manifests in the intergenerational and urban/rural digital divide.

The intergenerational digital divide

During the Covid-19 pandemic the Chinese government rolled out various digital technologies for management. Many people could get instant access to news and work online through remote collaboration software, schools switched to online instruction tools, and food and daily necessities could be ordered online without leaving home. However, many people with low digital literacy faced limited information, limited access to transportation and stores due to lacking a "Health code" identifying Covid infection risk in China. difficulty registering for medical appointments, and difficulty to reserve taxis or order food delivery[20] Therefore, not having access to digital services during a pandemic has become a functional limitation for many older adults. In the first 3 months after the outbreak of the COVID-19, the number of middle-aged and older adult internet users in China increased by 61 million. In such a short period, the pandemic prompted a growth rate that had not been achieved in the prior 10 years. Many people struggle and even fall into the trap of false information inducement and fraud.

The digital divide between urban and rural areas

The digital divide between urban and rural areas is a manifestation of the continuous accumulation and enlargement of urban−rural differences in the process of digital transformation. According to information released by the China Internet Network Information Center, there were 285 million rural netizens in China, accounting for 30.4% of the total netizens, which is in sharp contrast with 654 million urban netizens, accounting for 69.6% as of June 2020.[21] Meanwhile, the internet user percentage in rural and urban area were 57.6% and 81.3% respectively as of December, 2021.[21] Data from the China Longitudinal Aging Social Survey in 2016 also show that the digital divide among older adults is huge. For example, 28.7% of urban adults older than 60 own a smartphone, compared to only 7.4% in rural areas.[17] The construction of rural digital infrastructure is still in its infancy, and the use and promotion of smart eldercare or information technology services are minimal. Moreover, the old-age security system is not perfect, older adult care methods are simple, and education and economic status are low in rural areas. Thus, digitalization and intelligence have created a digital divide between urban and rural older adults leading to disparities in access to care and services.

Critical issues in smart eldercare

Commonality and individuality

When examining the needs of older adults, in addition to their common characteristics, heterogeneity should also be considered. For a long time, researchers and the aging industry has ignored the diverse and individualized needs of older adults, but individual health status, family structure, living arrangement, and life course all have an impact on older adults' needs. Thus, there are also differences in the type and intensity of their demand for service items. Individuals often change their needs due to social and individual stage changes and new needs arise from time to time. There is a lack of research on heterogeneity and the limitations of macro research frameworks. This shortage causes a serious shortage of targeted product development and effective supply of personalized health management, special medical services, and health education on special topics.[22]

Modern versus traditional

Modern technology may be seen as a double-edged sword for some older adults. While promoting social development, technology can expand disparities for older adults.[12] Smartphone-based technologies mainly target young people, so their product design is often not suitable for older adults with visual, auditory, and other physical function issues.[23] In the pursuit of practicality, efficiency, and automation, many companies develop products that need to have many paying customers, while a low bar to entry for the competition and unforeseen risks, mean some technologies are not available for very long. Thus, we should

reflect on the idea of blindly expecting older adults to adapt to the modern and rapidly developing information society. Some questions need to be considered: How can we balance the relationship between modern and traditional views? Are there any merits to traditional forms of social engagement? Why is there still a market for the "whole person well-being" of traditional Chinese medicine and the concept of preventive treatment of disease in today's society, where modern medical technology has developed so maturely?

Science and humanities

Scientific discoveries have led to the sensory and processing capabilities of technology. Humanistic human services are often based on more traditional artistic and social interactions. These two concepts are not mutually exclusive and cannot replace each other's functions, especially in serving older adults who need not only health and well-being monitoring services but also want human-centered care and respect, which are frequently beyond the reach of technological products.[12] Therefore, in such a situation, bridging the two functions or even better displaying humanity in scientific and technological services is the most suitable way to improve older adults' care services. Moreover, the original intention of product design should always be to better assist older adults and their caregivers rather than replace their functions.

To conclude, technologies are rapidly changing our expectations and capabilities to manage a rapidly aging population. There is tremendous potential for improved quality of life and extended autonomy and dignity for older adults in the future. Unfortunately, not everyone has been able to take full advantage of the rapid improvements in technology leading to a digital divide that can be related to age, location, education, and income. The implantation of technology often creates barriers of cost, access, digital self-efficacy, and cognitive capacity, awareness of its existence, and consistency of its availability from private businesses struggling to realize returns on their initial investments. We face the opportunity to change the perspective of the institutional, home-based, and community-based service providers on technology to enhance autonomy and dignity for frail and disabled older adults. Technology can lead to programs that scale up to benefit millions of people who currently have limited professional care or medical care access. We are optimistic that new technologies can expand access to expert care and improve length and quality of life for many. An interdisciplinary effort to enhance autonomy among older adults can lead to more sustainable aging societies, step by step.

Limitations

There are limitations to the use of the Delphi method as it cannot produce a right or wrong answer, and can be biased based on the individuals selected. By design, the technique is based on opinion and is greatly affected by the interests of the researchers. This approach highlights knowledge of topic experts and has the potential to identify key issues driving forward or hold back the field from reaching its full potential. Older adults in China have had an education and life history which differs greatly from people in Europe or the US, where most related research is conducted. The effort to develop culturally appropriate interventions, that address the universal challenges of aging and the unique needs of Asian older adults could enlighten the design of future interventions.

Contributors

Chen drafted the first manuscript, Hagedorn and An extensively revised the paper structure, An and Chen applied the funding jointly. All three authors conducted data analysis for the research together.

Declaration of interests

None.

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