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Barriers to Digitally Inclusive Government-led Smart Elderly Care in Beijing, China

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Abbreviations

Adj. R^2	Adjusted R-squared
AGFI	Adjusted Goodness of Fit Index
AI	Artificial Intelligence
CFI	Comparative Fit Index
GFI	Goodness of Fit Index
IFI	Incremental Fit Index
IoT	Internet of Things
ITU	International Telecommunication Union
NFI	Normed Fit Index
Num. obs	Number of observations
PPP	Public-Private Partnership
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
UN	United Nations

Symbols

df	Degrees of Freedom
Sig.	Significance
R^2	R-squared

Abstract

Population aging, as a temporarily irreversible trend, presents unprecedented challenges worldwide. In Beijing, China, the large elderly population coupled with currently inadequate elderly care services poses significant societal challenges in elder care. Smart elderly care, which can efficiently deliver elderly care services and accurately match elderly care resources, is considered an innovative method for providing elderly care services and a proactive approach to addressing elderly care challenges. Currently, Beijing government is beginning smart elderly care initiatives by providing smart elderly care devices to senior residents, establishing community elderly care service centers as providers of smart elderly care services, and setting up the "Beijing Elderly Care Service Website," aiming to offer inclusive social welfare elderly care services to residents.

However, the "smart" nature of smart elderly care also raises challenges related to "digital inclusiveness" in society. According to van Dijk's digital divide theory, there are access gaps in smart elderly care services or smart devices, digital skills knowledge gaps among the elderly, and usage gaps where the effectiveness of usage is not as expected, throughout the process from provision to usage of government-led smart elderly care services in Beijing. The existence of these gaps threatens the effectiveness of smart elderly care.

This thesis investigates the digital inclusiveness of government-led smart elderly care in Beijing focusing on the current level of digital inclusiveness, influencing factors of digital inclusiveness, and possible measures to improve digital inclusiveness. By collecting data through questionnaire surveys for statistical analysis and conducting semi-structured interviews for text analysis, this study finds out that the digital inclusiveness of government-led smart elderly care services in Beijing is currently insufficient. In addition to the general influencing factors of inclusiveness as social welfare in elderly care, the influencing factors of digital inclusiveness in smart elderly care services include the level of access to smart elderly care services, the digital skill levels of smart elderly care service users, the acceptance level of smart elderly care service users, and the technology’s elderly friendliness. Feasible improvement measures include making smart elderly care more elderly-friendly, government providing more practical policies, reducing potential operational risks for elderly care service providers, and enhancing comprehensive regulation of smart elderly care.

1 Introduction and Problem Statement

With the improvement of economic development and advancements in the field of healthcare, the life expectancy of populations worldwide has continuously increased (World Health Organization, 2020). However, along with the declining fertility rates, many societies in the world are facing a new challenge: the deepening degree of population aging (Yang et al., 2021).

An aging population is a shift in a country's population distribution toward older individuals (Weil, 2006). This may lead to insufficient economic development momentum, increasing burden on public finance system and healthcare systems, while imposing heavier pressure on families to support the elderly (OECD, 2019; Maestas et al., 2023; Liu et al., 2020).

The advancement of technology aims to enhance overall work efficiency for humanity and provide more convenience and comfortable experiences (Hassenzahl, 2010). The application of modern ICT technologies in healthcare, caregiving, and other fields has made smart elderly care a reality. Smart elderly care refers to the comprehensive integration of emerging information technologies such as the Internet of Things (IoT), big data, and artificial intelligence (AI) into the elderly care service system (Alshehri & Muhammad, 2021). Smart elderly care encompasses the entire process of family, community, and institutional elderly care, providing personalized, efficient, and intelligent health management, daily care, and spiritual support services to the elderly, thereby achieving precise allocation of elderly care resources (Alexopoulou et al., 2022; Alshehri & Muhammad, 2021). Smart elderly care is considered an effective means of improving the quality and efficiency of elderly care services, extending and supporting the independent living of the elderly on one hand, and assisting caregivers and simplifying their activities on the other (Maresova et al., 2020; Alexopoulou et al., 2022). Globally, the prevalent trend is the adoption of smart elderly care, which is seen as a beneficial attempt to alleviate the pressure of population aging (Jacob Rodrigues et al., 2020).

Despite the generally promising outlook for smart elderly care, the transition from design and planning to implementation is not straightforward. The success of smart elderly care relies heavily on a stable information and communication network, as well as smart devices (Lu & Lin, 2018). To scale smart elderly care, substantial investments are needed in funding, technological research and development, the construction of service networks, and the training costs of relevant service personnel (Hung, 2022).

These factors, to some extent, constrain the current development of smart elderly care (Hung, 2022).

1.1 Beijing, China as a Case

Currently, China is experiencing a significant level of aging (United Nations, 2022). Meanwhile, Chinese children are under greater pressure to care for their parents than previous generations, because of one-child policy and accelerating population mobility (Hung, 2022; Bao et al., 2022). As a socialist country with a long tradition of collectivism, the Chinese government is expected to provide elderly care services as a public good (Zhang et al., 2020). However, it has limited fiscal resources and cannot provide completely free care services to the elderly as it is still a developing country (Zhang et al., 2020). It is generally recognized that elderly care services in China are quasi-public goods, characterized by partial non-excludability and partial non-rivalry (Zhang et al., 2020).

As the capital of China, Beijing has a resident population of 21.542 million, among which the elderly population is substantial (Beijing Municipal Health Commission, 2023). The population aged 60 and above has reached 4.14 million, accounting for 29% of the total population, while those aged 80 and above number 699,000, making up 3.2% (Beijing Municipal Health Commission, 2023). It is projected that by 2035, the proportion of elderly people in Beijing will reach 30%, indicating a super-aged society according to United Nations standards. The elderly dependency ratio in Beijing, calculated as the number of people aged 65 and above divided by the working-age population (15-64 years), stands at 32.7% (Beijing Municipal Health Commission, 2023). This means that for every elderly person, three working-age individuals are supporting.

For providing elderly care services, the Beijing municipal government follows a pluralistic welfare approach. Pluralistic welfare emphasizes delivering welfare services through various channels and stakeholders to meet the diverse needs of society's members (Rose et al., 1986). The government is not the sole provider of welfare but collaborates with families, communities, and the market, therefore building a comprehensive elderly care system (Rose et al., 1986).

In practice, Beijing has drawn on the experiences of countries and cities facing aging societies, such as the UK, Germany, Japan, and Hong Kong (Beijing Municipal Civil Affairs Bureau, 2015). The government has adopted a fundamental strategy that emphasizes "home-based care as the primary form, community care as a supplement,

and institutional (commercial) care as a backup." (Beijing Municipal Civil Affairs Bureau, 2015). Special attention is given to elderly individuals with disabilities and dementia, considering them as key recipients of care services (Beijing Municipal Civil Affairs Bureau, 2015). Furthermore, the establishment of a long-term care system is regarded as a critical component of the elderly care service framework (Beijing Municipal Civil Affairs Bureau, 2015).

In recent years, the Beijing Municipal People's Congress and Beijing Municipal Government has continuously introduced policies, industry standards, and regulations to alleviate the social pressures brought about by aging. These (as shown in the table below) aim to enhance both the quantity and quality of elderly care services and, standardize the development of the elderly care industry in the city.

Year	Title	Content
2015	Regulations of Beijing Municipality on Home-based Elderly Care Services	Enterprises and social organizations engaged in home-based elderly care services benefit from government policy support and are required to follow government-established service norms and standards, while also accepting government guidance and social supervision.
2015	Beijing Municipal Special Plan for Elderly Care Facilities (2015-2020)	The government ensures basic services, while the market provides diverse options.
		Increase the per capita allocation of land for elderly care facilities and the number of beds in elderly care institutions.
		Establish elderly care centers in streets and townships to achieve basic coverage in urban and suburban areas.
2017	Construction Plan for Community Elderly Care Service Centers in Beijing (2016-2020)	The government will effectively fulfill its role in elderly care services, the elderly care service market will be fully developed, and the home-based elderly care service needs of the public will be promptly and effectively met.
2020	Implementation Plan of Beijing Municipality on Accelerating the Development of Elderly Care Services	Adhere to government leadership and establish a comprehensive elderly care service guarantee system.
		Strengthen basic elderly care service for specific populations.
		Develop a comprehensive elderly care service supervision system (including safety supervision, financial fund supervision, and service quality supervision).
2020	Measures of Beijing Municipality for the Implementation of Training and Cultivation of Elderly Care Service Talents	Government support for the market in providing specialized and tiered training for pension service professionals.
		Government provides bonuses and subsidies to full-time workers in the pension industry and recent graduates.
2021	Beijing Municipal Special Plan for Elderly Care Services (2021-2035)	Address population aging, promote new economic growth points, and expand employment opportunities.
		Build an age-friendly society.
		Foster innovation and research in the eldercare industry, enhance the technological level of elder care services.
2021	Operational Support	Provide basic subsidies, management service subsidies,

	Measures for Community Elderly Care Service Centers in Beijing	brand chain subsidies, and operational maintenance subsidies for community elderly care service center operations.
2021	14th Five-Year Plan for the Development of the Aging Undertaking and Elderly Care Service System in Beijing	Promote the transformation of technological achievements for the elderly
		Establish an interconnected aging health information coordination and decision support platform
		Support the intelligent upgrading and renovation of elderly care institutions
2023	Work Plan for the Construction of Home-based Elderly Care Service Network in Beijing	Strengthen the construction of home-based elderly care facilities.
		Improve home-based elderly care service network.
		Enhance the effectiveness of home-based elderly care services.
2024	Guidelines for the Construction and Management of Regional Elderly Care Service Centers at the Street/Township Level in Beijing	The street (township) level regional elderly care service center features functions such as matching supply and demand for elderly care services, scheduling and supervision, community dining, senior education, wellness and entertainment, and centralized elderly care.
		In principle, local governments provide these facilities free of charge, recruiting service operators through a space-for-service model.
2024	Management Measures for Star-Rating of Elderly Care Institutions in Beijing	The civil affairs department determines star ratings of elderly care services.

Table 1.1 Policies, industry standards, and regulations related to elderly care implemented in Beijing (2015-2024)

One significant approach, besides encouraging qualified elderly care service brands, social organizations, or enterprises to establish small branches within communities, is the adoption of the Public-Private Partnership (PPP) model (Beijing Municipal Committee on Aging, 2016). The PPP model involves collaboration between the government and private capital to promote the construction and operation of elderly care facilities. According to the Beijing Municipal Committee on Aging (2016), the government provides land, which is then used by social organizations or enterprises to build new service centers. After an agreed-upon operational period, these facilities are transferred to the government at no cost.

Due to societal, cultural, economic and psychological factors, home-based elderly care (or aging in place) remains the preferred choice for most Chinese families (Fu & Chui, 2019; Zeng et al., 2014). According to the definition of home-based elderly care by Beijing Municipal People's Congress (2015), it is a model of elderly care that is "Family-centered, government-led, community-based in urban and rural areas, and supported by the social security system. The government provides basic public services, enterprises and social organizations offer specialized services, and grassroots mass

organizations and volunteers provide public welfare and mutual aid services, aiming to meet the social service needs of elderly people living at home." Over 99% of elderly in Beijing opting for aging in place while less than 1% choose to live in nursing homes (Beijing Municipal Health Commission, 2023). Additionally, more than 90% of the severely disabled elderly prefer to age in place (Beijing Municipal Health Commission, 2023).

To accommodate the preference of the elderly for home-based care or aging in place, the Beijing government strongly supports the development of a diverse, regional, and embedded home and community-based elderly care service network (Beijing Municipal Civil Affairs Bureau, 2021). This network aims to provide accessible, inclusive, and professional elderly care services nearby (Beijing Municipal Civil Affairs Bureau, 2021). Initiatives include the government-led establishment of community elderly care centers, the provision of professional personnel by order in-home elderly care services (such as assistance with cleaning and medical support), and home modifications to make living environments more age-friendly (Beijing Municipal Civil Affairs Bureau, 2021). These measures enable elderly individuals and their families to access necessary medical care, daily living assistance, and social and recreational services either at home or at nearby elderly service centers (Beijing Municipal Civil Affairs Bureau, 2021). Community-based elderly service centers not only geographically form a network but are also digitally connected with district-level civil affairs departments, allowing for real-time monitoring by the civil affairs authorities. However, there are significant disparities in the coverage density of elderly service centers across different administrative districts, with about half of the communities still lacking a community elderly service center (Yang, 2020).

Additionally, the government is attempting to integrate technology into the elderly care, striving to transform the pressures of an aging population into new drivers of technological advancement and economic growth (Beijing Municipal Civil Affairs Bureau, 2021). Similar to the New Robot Strategy introduced by Japanese government and the Active Assisted Living Program implemented by the European Union, Beijing is advancing the design, development, and promotion of smart elderly care technologies, ‘considering technologies as resources that can complement the ageing competences of older people and adapt in a variety of ways’ (Giaccardi et al., 2016). The municipal government, through policy support and financial subsidies, encourages enterprises to develop and promote health management wearables, smart elderly monitoring devices, and household service robots (Beijing Municipal Civil Affairs Bureau, 2021). The government provides subsidies for families to install smart health monitoring devices, emergency call systems, and smart home equipment, thereby facilitating the widespread

adoption of smart elderly care solutions in households (Beijing Municipal Civil Affairs Bureau, 2021).

Furthermore, in 2023, Beijing launched an integrated information platform for all elderly care services across the city, known as the "Beijing Elderly Care Service Website". This platform enables online information queries, consultations, virtual experiences, service ordering, and user reviews. Nearly a year into its operation, statistics from the Beijing Civil Affairs Bureau indicate that the platform has facilitated services for 51,100 users as of May 2024.

In supporting the elderly population, Beijing connects with grassroots communities and encourages residents to use government-led smart elderly care services. Elderly residents in Beijing can access corresponding free services and discounts through their identification documents (the People's Government of Beijing Municipality, n.d.). Additionally, Beijing provides care subsidies for elderly individuals who are disabled or have lost the ability to care for themselves through elderly subsidy accounts. The subsidy ranges from 200 to 600 RMB per month and can be used with elderly care and disability service providers throughout the city (the People's Government of Beijing Municipality, n.d.).

1.2 Problem Statement

Even so, the promotion and utilization of smart elderly care equipment and services in Beijing still face significant challenges related to digital inclusion, despite the promising prospects for smart elderly care and the implementation of a series of incentive policies by the Beijing municipal government to support it.

From the perspective of the recipients of smart elderly care, similar to other smart products and services, smart elderly care faces the issue of the digital divide. The digital divide typically manifests in three main areas: lack of access, lack of related skills, and inability to achieve the intended benefits (Van Dijk, 2012). The existence of these digital gaps prevents some elderly individuals and their families from equally enjoying the conveniences brought by smart elderly care, thereby seriously challenging digital inclusion and undermining social equity. From the perspective of the providers of smart elderly care, the current technical, organizational, and environmental conditions in Beijing are not perfect. This may temporarily prevent the services from achieving digital inclusiveness.

The current academic discourse has addressed the digital inclusiveness of various intelligent technologies. Scholars have introduced the concept of the "silver digital

divide" to describe the digital gap faced by the elderly population in using smart products and services (Choudrie et al., 2013). However, most existing research focuses on the acceptance and use of specific devices and technologies by the elderly in particular contexts, such as the operation of smartphones and applications (Li & Kostka, 2024) and the use of ICT-based health monitoring devices (Vicente, 2021).

There is a lack of research that holistically considers whether home-based elderly care services provided by the government and private sector are sufficiently digitally inclusive in the context of aging in place. Moreover, there is a notable scarcity of studies that explain the causes of this issue and explore potential solutions from the perspective of public management and public policies.

Thus, this paper takes the author's former city of residence, Beijing, China, as a case to pose the following research question: *What are the barriers to digitally inclusive government-led smart elderly care in Beijing?*

- Sub-question 1: From the perspective of the elderly care recipients, what are the barriers to digitally inclusive government-led smart elderly care?

- Sub-question 2: From the perspective of the elderly care providers, what are the barriers to digitally inclusive government-led smart elderly care?

Due to the distinctly different behavioral characteristics and significant numerical disparity between the recipients and providers of elderly care services, this study will employ a mixed-methods approach combining qualitative and quantitative social science research methods to analyze the two research questions separately. The prominent feature of the mixed-method approach is its flexibility in combining the strengths of both quantitative and qualitative research methods, providing a more comprehensive understanding of the research topic and enhancing the credibility and reliability of the research findings (Ivankova et al., 2006).

In this paper, firstly, I formulate research hypotheses and construct a research model based on the literature review. Data is then collected through questionnaires and analyzed using SPSS and Amos software to perform descriptive statistics, statistical analysis and structural equation modeling for hypothesis testing. Additionally, I conduct semi-structured interviews with staff at community senior service centers, and elderly individuals and their families. These interviews are transcribed and coded using NVivo to provide necessary explanatory supplements to the research questions addressed in the article. Lastly, regarding the current operation of the "Beijing Elderly Care Service

Website", I submit a formal request for information disclosure to the relevant departments in Beijing and receive a written response.

2 Literature Review

2.1 Digital Gap

ICT—Internet, mobile phones, and all other tools that collect, store, analyze, and share information digitally—have brought diverse choices and development opportunities to people. At the same time, the development of ICT has contributed to national economic growth and the dissemination and exchange of social and cultural aspects (Palvia et al., 2018; Matei & Savulescu, 2012). However, with the continuous development, iteration, and use of technology, the issue of the digital divide has also emerged.

The concept of the digital divide originated from the "knowledge gap" hypothesis proposed by Tichenor et al (1970). It was posited that in the process of mass media information dissemination, individuals with higher socio-economic status have an easier time accessing knowledge and information compared to those with lower socio-economic status (Tichenor et al., 1970). With the proliferation of the internet, the "knowledge gap" created by traditional media gradually evolved into an information disparity and knowledge segregation based on different groups and regions, leading to the concept of the "digital divide" (Srinuan & Bohlin, 2011). In the 1990s, the US Federal Communications Commission defined the digital divide as the gap existing in the development and application of information technology (Srinuan & Bohlin, 2011).

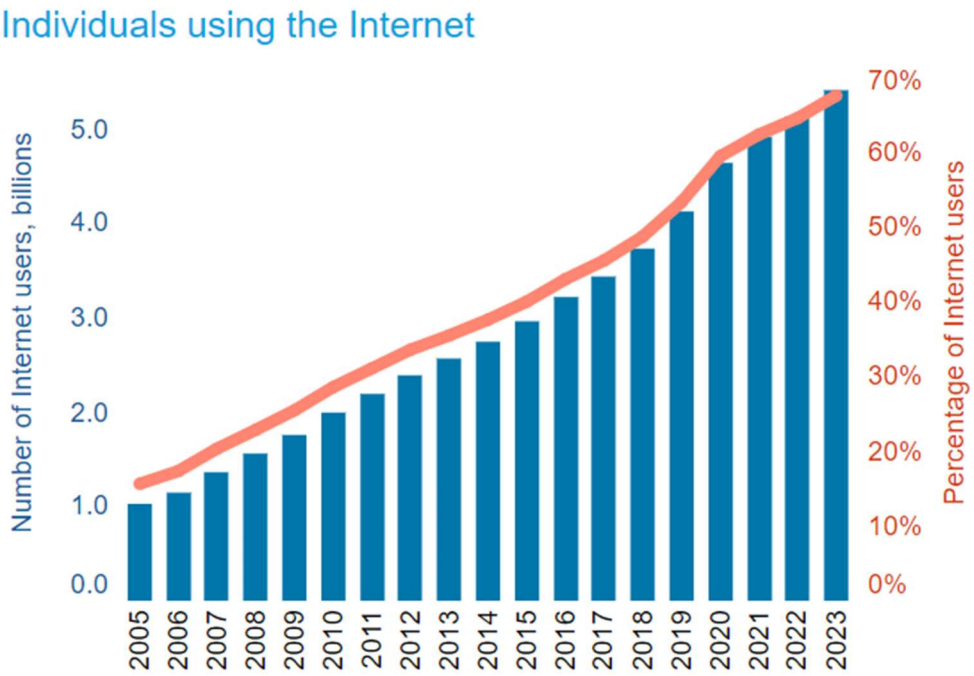
As digital technology continues to advance, the concept of the digital divide has become dynamic and multi-dimensional. The current academic discourse on the definition of the digital divide encompasses three levels：access gap, skills gap and usage gap (Campos & Scherer, 2023; Alexopoulou et al., 2022). In general, these three levels are fundamentally based on the access gap, which is further deepened by the skills gap, ultimately affecting the usage gap. However, even within specific populations, these three levels can also exhibit significant variations at the individual level.

2.1.1 Access Gap

The first level, known as the "access gap", is typically defined as the disparity between those who can and cannot use information and communication technology (ICT) and related infrastructure (van Dijk, 2002). The International Telecommunication Union (ITU) highlights inequalities in accessing ICT associated to differences of age, gender, socioeconomic status and geography (ITU, n.d.-a). Multiple studies have indicated that older adults have a lower rate of access to the internet and smart devices compared to young and middle-aged adults, as well as children （Czaja & Lee, 2006; Shi et al., 2021）. Additionally, women, in general, are at a greater disadvantage than men in

accessing ICT (Acilar & Sæbø, 2021; ITU, n.d.-b). In 2019, 87% of the population in developed countries had access to the internet, while the proportion in developing countries was only 47% (Digital Inclusion, n.d.).

In recent years, due to development of infrastructure and government policies and initiatives, the proportion of the global population with access to the internet has been increasing (ITU, 2023). According to the International Telecommunication Union, the number of internet users in low-income countries continues to increase, with approximately 17% growth in 2022 (ITU, 2023). Currently, 67% of the global population, or 5.4 billion people, are connected to the internet (ITU, 2023). In this regard, it can be said that the access gap is continuously narrowing.



Source: ITU (2023)

Figure 2.1 Individuals using the Internet

The divide in the use of smart phones and wearable technologies has also increased, which has lead to a new digital divide or mobile digital divide (van Deursen & Mossberger, 2018). According to the study by Chandrasekaran et al. (2021) and Yang et al. (2022), currently, only a small number of elderly individuals use wearable medical devices, and disparities in race and income hinder their use among older adults. Older adults with higher incomes and more positive attitudes towards technology are more likely to access digital tools (Yang et al., 2022).

The study by Li and Kostka (2024) points out that physical impairments, such as disabilities or age-related conditions (e.g., poor vision, dexterity issues), complicate access. Many older adults find it challenging to use devices with small screens and complex interfaces (Li & Kostka, 2024). These physical barriers can lead to frustration and eventually result in disengagement from digital technologies.

In addition, language also leads to the access gap in the digital society. Although there are over 7,000 languages worldwide, Unicode, the standard for text and emoji, supports only about 150 of them (Kupfer, 2023). English content accounts for more than half of the online written material, despite only about 16% of the global population speaking English (Kupfer, 2023). Furthermore, many software applications, operating systems, and smart devices lack localization support for minority languages (Osborn, 2007). These circumstances create barriers for many non-dominant language speakers in accessing information and services on the internet.

The access divide will further widen as people's opinions about technology are reinforced by their use or non-use of it. Ghorayeb et al. (2021) conducted a survey on whether elderly individuals are willing to use new smart home technologies. The results showed that elderly individuals who are already using smart home technologies have higher acceptance and are more actively engaged in their use, whereas non-users tend to have a negative attitude. This underscores the continued relevance of exploring the first level of the digital divide.

2.1.2 Skills Gap

The second level of the digital divide, known as the "skills gap" or "literacy gap," focuses on people's unequal ability to use information resources and operate information devices (van Dijk, 2002).

It encompasses differences in operational or instrumental skills needed to command digital media (medium-related skills) and substantial skills geared toward finding information, communicating, acting, and creating (content-related skills). Gran et al. (2021) also point out that in recent years, there is a subtler problem of digital divide between those who are algorithm-aware and those who are not, which also presents a challenge for society to solve. Moreover, scholars have noted that the ability to operate large language models such as ChatGPT creates new digital divides and bring about significant transformations in fields such as education and healthcare (Mhlanga, 2023; Korzyński et al., 2023; Li, Dada, et al., 2024).

Most current research on the digital divide concentrates on these "skills gap," which represents the primary manifestation of the contemporary digital divide. The impact of this divide varies across different demographic groups, with significant disparities in terms of age, gender, race, and immigration status (Bergson-Shilcock, 2020). Older adults, women, and ethnic minorities are at a disadvantage in surveys of digital capacity (Martínez-Alcalá et al., 2021; Antonio & Tuffley, 2014; Rickard Domeij et al., 2019).

Moreover, research indicates that educational attainment is a crucial determinant of digital literacy. Individuals with higher levels of education are more likely to possess the skills necessary to effectively navigate and utilize digital technologies. Digital literacy can complement traditional literacy, and deficiencies in basic education may exacerbate existing inequalities in digital skills (Reddy et al., 2023; van de Werfhorst et al., 2022). Li and Kostka (2024) mention that older adults with higher levels of education exhibit greater self-motivation and openness towards learning and using digital technologies. Moreover, older adults often lack motivation, including interest in technology and willingness to engage, which further exacerbates the digital divide in gaining digital skills to operate smart technologies (Yang et al., 2022).

Additionally, social inclusion issues brought about by the skills gap cannot be overlooked. Individuals lacking digital skills are often excluded from digital networks that facilitate communication and access to information and services (Elahi, 2020). Many older adults lack digital literacy, which includes the basic skills needed to operate devices, navigate the internet, and use digital services. This lack of skills can hinder them from benefiting from online services and staying connected with family and friends (Jesper Holgersson et al., 2019; Mubarak & Suomi, 2022). Sin et al. (2021) conducted an interview study on the use of digital technology among the elderly during the COVID-19 pandemic. They found that although the number of elderly individuals proficient in digital technology has rapidly increased, the digital divide not only persists but is also exacerbated by the large-scale development and use of purely virtual products, leaving those who have not adapted to the digital world increasingly disadvantaged. This exclusion can lead to increased social isolation, particularly among older adults and marginalized communities (van de Werfhorst et al., 2022; OECD, 2001).

Another significant negative impact of the skills gap is cybersecurity threats. Individuals with lower digital literacy are more susceptible to online fraud, phishing attacks, and misinformation (Li et al., 2024). For example, a study found that digital literacy is crucial for helping residents avoid becoming victims of fraud, with those lacking digital skills being more prone to online and telecommunication fraud (Naurin

Farooq Khan et al., 2023; Li et al., 2024). This vulnerability not only affects individuals' financial security but also their trust in digital technologies, further exacerbating the digital divide (Naurin Farooq Khan et al., 2023).

2.1.3 Usage Gap

The third level, referred to as the "usage gap" or "outcome gap," emphasizes the outcomes achieved by different users when employing ICT technologies. This concept extends beyond mere access or adoption of new technologies, highlighting the disparities in benefits realized by users who have similar levels of access and adoption (van Dijk, 2002). It encompasses whether the expected usage outcomes are attained, whether users are satisfied with their usage, and whether they are willing to use the technology again.

Choudrie et al. (2013) conducted a study on the use of e-government systems by the elderly population in London, UK, employing a mixed-methods approach have found that the benefits of the internet for many users are relative and depend on factors such as the user's age, cognitive abilities, and level of innovativeness. Helsper and Reisdorf (2017) investigated the gaps in internet usage within British society. Their research indicates that despite high internet penetration rates, certain groups, such as older adults and those with lower socioeconomic status, derive fewer positive outcomes from internet use compared to younger and wealthier individuals. These disparities are related to differences in digital skills, self-efficacy, and the types of online activities in which these groups engage.

In the field of education, ICT integration is considered a means to enhance learning outcomes and bridge educational gaps. However, research by Hohlfeld et al. (2017) indicates significant disparities in the effectiveness of students' use of ICT. While some students experience improvements in academic performance and engagement, others struggle to realize these benefits due to differences in digital literacy, access to quality resources, and instructional support.

In the healthcare field, doctors, nurses, and other healthcare workers who are not very familiar with ICT tools may find it challenging to effectively integrate these technologies into their workflows. According to Nguyen et al. (2021), healthcare providers' proficiency in using electronic health record systems directly impacts their ability to leverage these tools to improve patient care. Zhou et al. (2009) found that healthcare providers who perceive ICT tools as beneficial and easy to use are more likely to report high satisfaction and a willingness to continue using these tools. From the patients' perspective, Polinski et al. (2015) demonstrated that telemedicine shows

potential in increasing access to healthcare, but its effectiveness is often hindered by technical barriers and users' negative emotional attitudes. Krebs and Duncan (2015) indicated that while mobile health applications are widely downloaded, their sustained use is limited. Factors such as user engagement, app usability, and perceived benefits significantly influence long-term usage.

Similar to the other two gaps, the usage gap can have profound impacts across various fields, including education, employment, healthcare, and civic engagement (Gallistl et al., 2021; Holgersson & Söderström, 2019). Additionally, the usage gap can exacerbate the digital divide and perpetuate social inequalities. Those who are unable to fully benefit from information and communication technologies may face reduced opportunities for civic participation, access to information, and engagement in digital spaces, which can lead to further marginalization and exclusion (Gallistl et al., 2021).

In summary, the usage gap represents a critical challenge in the adoption and utilization of new technologies. While access to digital technologies and digital skills are essential prerequisites, they do not guarantee equitable outcomes or benefits for all users. Addressing the usage gap requires a multifaceted approach, combining efforts to enhance digital literacy, increase user engagement, and design inclusive and user-friendly technologies. By recognizing and addressing the factors contributing to the usage gap, policymakers, technology users across various industries and technology developers can work towards ensuring that the transformative potential of new technologies is realized equitably, promoting digital inclusion and empowering individuals from diverse backgrounds.

2.2 Digital Inclusion

In the 2010s, public institutions worldwide recognized that the phenomenon where individuals or groups are excluded from the benefits of digital development due to their inability or unwillingness to use technology cannot be explained by the binary concept of the "digital divide" as simply "having or not having" access (Fu & Huang, 2023). Consequently, international organizations such as the UN began to propose and advocate for the concept of "digital inclusion" (Fu & Huang, 2023; Wright & Wadhwa, 2009; Borg & Smith, 2018; Jamil, 2020). Digital inclusion, or E-inclusion, is defined as ‘equitable, meaningful, and safe access to use, lead, and design of digital technologies, services, and associated opportunities for everyone, everywhere’ (United Nations, n.d.). This entails affordable access to technologies, the accessibility and usability of ICT tools and services, and the ability and skills of all individuals to use these tools (Eurostat, n.d.).

Based on the research by Fu and Huang (2023), the theories and practices surrounding "digital inclusion" can be categorized into two orientations: "goal-oriented" and "action-oriented." From the goal-oriented perspective, digital inclusion represents an ideal state where individuals and groups participate fully in the digital society by equally accessing and using digital technologies. This perspective emphasizes the equitable and comprehensive sharing of digital divides by all individuals. Specifically, in terms of personal technology use, digital inclusion aims for technological self-sufficiency, enhancing well-being through participation, collaboration, and innovation. Digital inclusion involves empowering and enabling individuals through technology to improve their economic status, quality of life, and social participation, ultimately achieving social inclusion (Weerakkody et al., 2012; Manda & Backhouse, 2018).

Furthermore, in creating a socially digital environment, the goal is to establish an open, diverse, and innovative technological usage environment that eradicates inequality through technology-driven and inclusion-driven initiatives (Thompson & Paul, 2016). This involves building a human-centered, sustainable, inclusive digital society. However, some scholars are not optimistic about the prospects of digital inclusion. Real et al. (2014) and Yu et al. (2018) argue that the rapid pace of technological development makes it difficult for people to achieve constantly evolving and progressively higher inclusion goals. Therefore, digital inclusion goals can only be realized in a limited number of contexts, such as achieving equality and sharing in internet access (Yu et al., 2018; Real et al., 2014).

Despite the challenges in addressing the root causes of digital inclusion—namely, structural social inequalities—action-oriented practices in digital inclusion continue to make efforts toward achieving this goal (Fu & Huang, 2023; Weerakkody et al., 2012; Manda & Backhouse, 2018; Afshar Ali et al., 2019). Specifically, improving access to technology by enhancing the affordability and accessibility of digital infrastructure, devices, content, applications, and design enables everyone to have high-quality access to technology and the internet (Barlott et al., 2019; Sharma et al., 2016; National Digital Inclusion Alliance, 2017). This is the most fundamental and widespread practice in digital inclusion (Fu & Huang, 2023). Additionally, in enhancing technological usage capabilities, increasing people's acceptance and adaptability to technology, and improving digital literacy levels, everyone can integrate into society to the same degree (Rundel & Salemink, 2021; Barlott et al., 2019; Salemink et al., 2017). At the same time, enhancing individuals' self-efficacy in using technology ensures that its intended utility is fully realized (Pawluczuk, 2020; Adam & Dzang Alhassan, 2021; Hosman & Pérez Comisso, 2020).

To achieve digital inclusion, the measures implemented for various specific groups emphasize different aspects (Fu & Huang, 2023). For the elderly, the focus is on two main areas: first, providing specialized skills training and encouragement to help them improve cognitive abilities and discover new interests (Ordonez et al., 2011). Secondly, modifying devices and applications elderly-friendly to enhance the sustainability of digital inclusion for the elderly population (Bossio & McCosker, 2021; Mariano et al., 2021).

For women, the measures concentrate on encouraging women to take on decision-making roles in the technology sector, reducing the safety risks associated with technology use, eliminating traditional stereotypes, and empowering women (Li & Chen, 2021; Mariscal et al., 2019; Martínez-Cantos, 2017; Pawluczuk, 2020). For young children and adolescents, digital inclusion measures emphasize strengthening the connection between government, family, school, and community, supporting schools, training professional teachers, and promoting youth employment (Newman et al., 2016; Khanlou et al., 2020; Sharma et al., 2016).

For individuals with disabilities, existing measures focus on adapting technology (such as using integrated, built-in accessibility tools instead of separate explicit assistive technologies) (Tsatsou, 2020; Goggin et al., 2017; Khanlou et al., 2020), and enhancing the usability of technology by providing high-level customized services, training, and support to reduce disability stigma (Ordonez et al., 2011). Additionally, while there is considerable scholarly attention to the digital exclusion and digital divide faced by ethnic minorities, specific measures targeting these groups remain largely absent in practice (Park & Humphry, 2019; Nedungadi et al., 2018; Fu & Huang, 2023).

2.3 Welfare Pluralism

Welfare refers to the various material and non-material benefits provided by society to redistribute resources, improve citizens' living standards, and promote social equity and justice (Rose et al., 1986; Gao et al., 2013). Welfare pluralism is a social policy concept that advocates for the provision of welfare services through multiple channels and forms, rather than relying solely on a government welfare system (Rose et al., 1986). This is specifically manifested in social insurance (primarily pensions and unemployment insurance), in-kind benefits (healthcare, housing, and food), and social assistance (mainly the minimum living guarantee, a basic safety net program targeting the poor) (Rose et al., 1986; Pinker, 1992; Gao et al., 2013).

The initial theoretical exposition of welfare pluralism was provided by Rose et al. (1986). They argued that the concept of the welfare state has been grossly

misinterpreted, equating the welfare state with the government being the sole provider of social welfare. Welfare should be a part of society, with the market, household, and state all participating in its provision (Rose et al., 1986). If any one of these—market, household, or state—is solely responsible for providing welfare, significant shortcomings are likely to occur (Rose et al., 1986). Therefore, it is necessary for the market, household, and state to collaborate to ensure the effective operation of the welfare mechanism (Rose et al., 1986).

Johnson (1987) further refined the system of social welfare providers, proposing that in addition to the "welfare triangle" of market, household, and state, there should also be a voluntary sector (Johnson, 1987). According to Johnson (1987), social welfare providers include: first, the public sector, which refers to direct or indirect welfare provided by the government; second, the informal sector, which involves community services and family care provided by friends, family, or neighbors; third, the voluntary sector, which mainly includes neighborhood organizations, self-help or mutual-aid groups, and non-profit organizations; and fourth, the commercial sector, which refers to occupational welfare provided by enterprises and purchased services in the market (Ding & Yang, 2015).

However, welfare pluralism has also been questioned. Some argue that the government's preference for welfare pluralism is a way for the government to shirk its own responsibilities (Ding & Yang, 2015). Additionally, other sources of welfare outside the government and market do not have a solid foundation. Overemphasizing decentralization and participation in welfare provision may lead to social stratification and result in certain groups lacking security and suffering from harm to their interests (Chen, 2003; Johnson, 1987). Furthermore, organizations with a public welfare spirit, including both for-profit and voluntary sectors, are not inherently efficient (Gilbert, 2009).

Gao et al. (2013) argue that China is indeed a welfare state, or at least very close to being one. Maintaining social order and stability has always been an explicit goal of the national social welfare programs (Gao et al., 2013). However, it is a highly differentiated welfare state between urban and rural areas: in Chinese cities, welfare is generous and progressive, but in rural areas, it is marginal and regressive. This differentiation is evidenced using different health insurance schemes for urban and rural residents, and the lack of pension contributions from work units for farmers before retirement, among other disparities (Gao et al., 2013).

Some scholars, such as Gao (2014), argue that China's current social welfare system for elderly people follows a residual model. A residual welfare system implies that the state

plays a limited role in social welfare. Apart from assuming primary responsibility for social assistance and basic social services, the government largely relies on the market, non-governmental organizations, and individuals for other social services and welfare provisions. Local governments in China play a primary role in implementing elderly welfare programs compared to the central government, with diverse approaches observed across different regions (Gao, 2014).

In line with other East Asian countries, China has a relatively small scale of social spending, strict state intervention and regulation, and significant disparities in treatment across social classes (Zheng, 2005; Gao, 2014). Compared to European countries, the trend towards familization of welfare is more pronounced (Zheng, 2005; Gao, 2014).

Furthermore, Gao (2014) summarizes the primary issues with the current elderly welfare system in China, which include: 1) limited coverage and low benefit levels, 2) lack of corresponding legislation, 3) insufficient financial investment etc..

3 Research Design

As Östlund et al. (2011) indicate, in healthcare-related studies, combining qualitative and quantitative research methods allows for a more comprehensive and unbiased examination of the complexities inherent in the phenomena under investigation. These two methods can be used sequentially, such as by conducting quantitative research first, followed by qualitative research, or vice versa (Hammarberg et al., 2016). However, it is essential to ensure that the theories underpinning each method are compatible and that the rationale for using these methods is appropriate (Hammarberg et al., 2016).

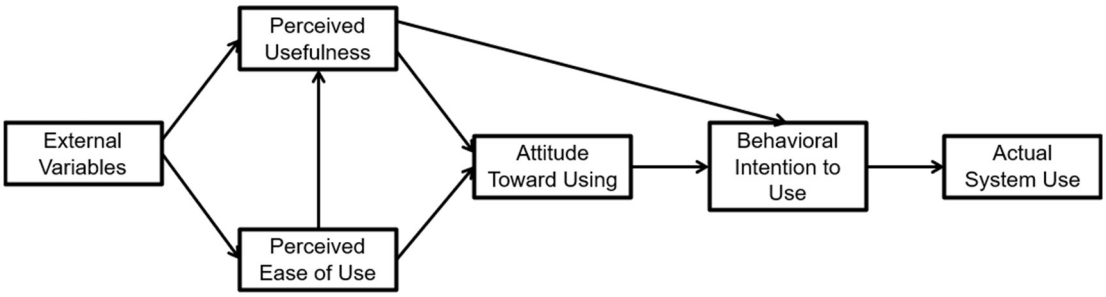
In this chapter, the design processes of both the quantitative and qualitative research involved in this study will be sequentially introduced. For the first sub-question: From the perspective of the elderly care recipients, what are the barriers to digitally inclusive government-led smart elderly care? The research subjects are the recipients of smart elderly care services, namely the elderly and their families. Given the large number of this group, a survey method will be employed through quantitative research. Additionally, semi-structured interviews will be conducted with a selected number of elderly households willing to participate, to help explain and supplement the findings from the quantitative data. For the second sub-question: From the perspective of the elderly care providers, what are the barriers to digitally inclusive government-led smart elderly care? This question targets the providers of elderly care services and involves specific processes and detailed issues that are difficult to quantify. Therefore, a qualitative research method, using semi-structured interviews, will be employed to analyze this question.

This study adheres to the ethical principles of voluntary participation, confidentiality, and non-maleficence (Foëx, 2009; Muthuswamy, 2013). Firstly, participants will be informed about the purpose, content, and methods of this study. The study will commence only after obtaining informed consent from the participants. Secondly, all personal information and questionnaire responses obtained during the study will be used solely for statistical analysis in this research. The confidentiality of the information will be strictly maintained. Lastly, this study is descriptive in nature and will not cause any adverse effects on the participants.

3.1 Quantitative Research

3.1.1 Theoretical Model: Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), introduced by Davis in 1989, is an innovative extension of the Theory of Reasoned Action. The TAM posits that perceived ease of use (PEOU) and perceived usefulness (PU) are fundamental determinants influencing users' acceptance of technology and their behavioral intentions. Perceived usefulness refers to the extent to which users believe that a service or product will benefit them, while perceived ease of use refers to the degree to which users feel that the product is controllable and easy to operate. The antecedent variables that influence these perceptions are collectively referred to as external variables. The model is shown in the figure below.



Source: Davis (1989)

Figure 3.1 Technology acceptance model (TAM)

Compared to other prospective models such as the Expectation-Confirmation Model in IT Domain (ECM-IT), the Theory of Reasoned Action (TRA), and the Theory of Planned Behavior (TPB), studies by Hong et al. (2006) and Mathieson (1991) have shown that the TAM model is more streamlined and offers better goodness-of-fit.

Since the publication of TAM, it has been widely used by scholars from various countries in different fields, particularly in the application of ICT. Park and Chen (2007) employed self-efficacy, the TAM, and Diffusion of Innovation theory to examine users' utilization and perceptions of smartphones. Chiu et al. (2009) integrated the two primary variables of the TAM, trust, and fairness to develop a model for investigating the motivations behind customers' loyalty intentions in online shopping. Lean et al. (2009) used the TAM model to analyze the factors influencing the acceptance of e-government systems among Malaysian citizens.

According to Holden and Karsh (2010), the TAM is usually used to predict the use of smart healthcare. Academics often add additional variables to the TAM to more accurately predict the phenomenon the phenomenon which they are investigated (Holden & Karsh, 2010). Often, variables are defined differently from paper to paper (Holden & Karsh, 2010).

TAM has widespread application in smart healthcare as it can explain provider and patient attitudes towards technology (Holden & Karsh, 2010). Many relationships between variables that TAM seeks to explain use of ICT within Smart Healthcare (Holden & Karsh, 2010). Perceived usefulness of a smart healthcare technology will have an impact on whether it is used (Holden & Karsh, 2010). This means that these technologies should ensure that they are improving outcomes and are not difficult to use (Holden & Karsh, 2010). Smart healthcare solutions should be designed around be clear, simple and unintuitive to use so patients want to use the software and trust it (Tu et al., 2022).

Tu et al. (2022) found that patients focus on the benefits of using smart health and whether they were trustworthy to use. Smart healthcare applications should be designed with cultural context in mind and from the perspective of the patient (Tu et al., 2022). Attitudes that elderly people have towards technology also influences whether they want to use Smart healthcare solutions or not (Tu et al., 2022). Some elderly patients may still prefer caretakers to help them in using smart services and favor traditional processes over technology (Tu et al., 2022). Both the technical and human side are important for smart healthcare, they should both complement each other (Tu et al., 2022). Elderly patients are more likely to use Smart healthcare solutions if they are taught by people their own age (Tu et al., 2022).

According to Zin et al. (2023) and Zhou et al. (2024), perceived usefulness, perceived ease of use, and facilitating conditions play a role in whether elderly people use Smart healthcare. TAM is a leading theory used in smart healthcare research to understand and predict if individuals end up using Smart healthcare solutions (Yan & Lee, 2022; Zin et al., 2023). Smart healthcare solutions should also acknowledge the spiritual and mental needs of elderly users (Zhou et al., 2024). Elderly users are unlikely to use smart solutions if it undermines their own self-worth (Zhou et al., 2024; Yan & Lee, 2022).

Furthermore, scholars have designed extended models for different research groups, such as the STAM for elderly people created by Chen and Chan (2014), model to study students (Chakraborty et al., 2008), and model to study healthcare professionals (Ilie et al., 2009). These studies demonstrate the flexibility and broad applicability of the TAM.

3.1.2 Variable Definition and Research Hypotheses

(1) Access

Van Dijk (2002) pointed out that the access gap refers to the situation where certain groups of people are unable to use digital technology due to the unequal distribution of physical and material access to digital technologies such as computers and the Internet. Accessibility, as a prerequisite for users to utilize smart technology, significantly affects their perceived usefulness and perceived ease of use of digital technology (Davis, 1989). In this study, the variable "Access" specifically refers to the physical conditions for users to access smart elderly care services, such as mobile phones and data networks, telephones and telephone signals, as well as the accessibility of smart elderly care services.

(2) Perceived ease of use

Perceived ease of use refers to the users' perception of the ease or difficulty of using smart elderly care services. This includes users' subjective judgment of the convenience of adopting new technology, their perception of the learning curve associated with using new technology, and the level of clarity in interacting with the technology (Li et al., 2019). Previous studies have shown that when users can physically access and use emerging technologies, they perceive the technology as easier to use (Davis, 1989; Ramli & Rahmawati, 2020).

Therefore, the following hypothesis is proposed:

- H1: The level of access to government-led smart elderly care services has a positive impact on users' perceived ease of use.

(3) Perceived usefulness

Perceived usefulness refers to the users' perception of the usefulness of smart elderly care devices and services. This includes users' anticipations of the effectiveness of adopting new devices and technologies, specifically in terms of improving efficiency and making life more convenient in the context of smart elderly care services (Li et al., 2019). Previous studies have shown that when users can physically access and use emerging technologies, they perceive the technology as more beneficial to them (Ramli & Rahmawati, 2020). Additionally, when users find emerging technology easy to use, they also perceive it as more useful (Davis, 1989; Nezamdoust et al., 2022).

Therefore, the following hypotheses are proposed:

- H2: The level of access to government-led smart elderly care services has a positive impact on users' perceived usefulness.
- H3: Users' perceived ease of use of government-led smart elderly care services has a positive impact on their perceived usefulness.

(4) Skills

Smart elderly care devices and services rely on ICTs. From the user's perspective, relevant digital skills are required to effectively utilize these devices or access the corresponding services. Based on the smart elderly care services and facilities currently provided in Beijing, this study evaluates respondents' digital skills primarily in terms of their ability to operate smart health monitoring devices, smart safety surveillance devices, seek smart elderly care services (such as browsing the web, making phone calls), and assist others in using smart elderly care devices or seeking smart elderly care services.

Moreover, several studies have shown that digital skills or self-efficacy related to information technology use can alter the strength or direction of the effect of perceived ease of use on perceived usefulness, suggesting a moderating effect (Igbaria & Iivari, 1995; Liang & Yeh, 2010).

Therefore, the following hypothesis is proposed:

- H4: The relationship between Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) of government-led smart elderly care services is moderated by the level of Skills (S).

(5) Attitude towards using

In the TAM, attitude towards using describes the overall emotional attitude of users towards a technology or system, regardless of whether they consider the system good or bad, wise or foolish, beneficial or harmful, effective or ineffective (Lederer et al., 1998). In this questionnaire, this aspect references the study by Chen and Lou (2020), asking respondents whether they think using smart elderly care services is a good idea and whether they have a positive attitude towards using these services.

Perceived usefulness and perceived ease of use are the two main factors influencing user attitudes. Systems that are considered useful and easy to use are more likely to be favored by users (Davis, 1989; Lederer et al., 1998).

Thus, the following hypotheses are proposed:

- H5: Users' perceived usefulness of government-led smart elderly care services has a positive impact on their attitude toward using these services.
- H6: Users' perceived ease of use of government-led smart elderly care services has a positive impact on their attitude toward using these services.

(6) Usage

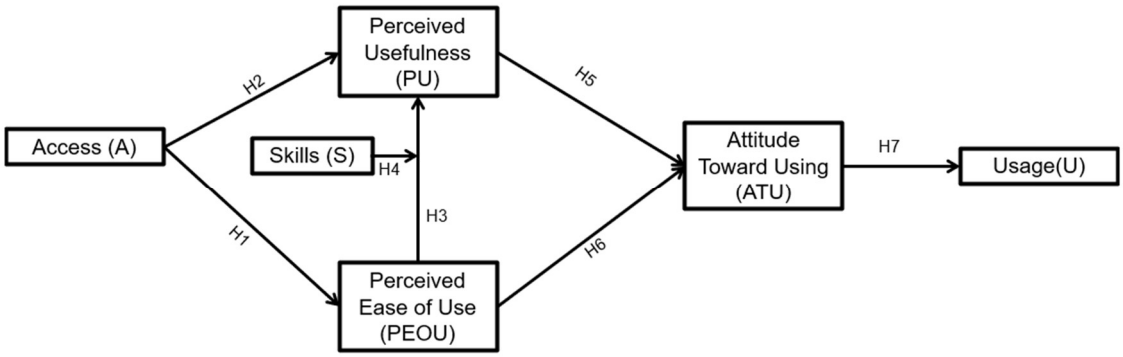
In the TAM, actual system usage, as the final variable in the research model, measures the actual outcomes or value users obtain from using the technology, demonstrating the tangible benefits or results gained from using the system (Davis, 1989). If users have a positive attitude towards using emerging technology, they are likely to experience more positive outcomes, use the technology more frequently, and engage with it to a greater extent (Davis, 1989; Clipa et al., 2023). In digital inclusion research, there are significant differences in the utilization effects of the same digital technology or service among different users (Scheerder et al., 2017; Ebbers et al., 2016). In this study, respondents are going to report their experiences with smart elderly care services in terms of reducing life stress and meeting elderly care needs.

Thus, the following hypothesis is proposed:

- H7: Users' attitude toward using government-led smart elderly care services has a positive impact on their level of usage access.

3.1.3 Research Model

Based on the research hypotheses, this study constructs a model of the factors influencing digital inclusiveness in government-led smart elderly care services, as shown in the figure below. The study retains the original variables of the TAM, namely perceived usefulness, perceived ease of use, and attitude toward use. On this basis, the model is adjusted and expanded to include three additional variables: Access level (A), Digital Skills level (S), and Usage level (U). Together, these variables form the model of factors influencing digital inclusiveness in government-led smart elderly care services.



Source: Author

Figure 3.2 Research model

3.1.4 Research Method: Survey

The survey method is a commonly used quantitative research method in the social sciences. Researchers create standardized questionnaires, distribute them to multiple respondents, and collect responses for analysis. Generally, the survey method features consistent question presentation, low cost, and confidentiality in the completion process (Groves, 2004). In recent years, more social science studies have utilized online survey platforms (such as Google Forms, Survey Monkey, etc.) for questionnaire design, distribution, and data collection and analysis (Putranto, 2019). Online survey methods significantly increase the speed of questionnaire dissemination, are not constrained by geographical distance, and can reach a larger pool of respondents (McRobert et al., 2018; Sue & Ritter, 2012, p. 7). Additionally, online surveys can collect diverse types of information (e.g., rankings, image uploads) and automatically save data, reducing errors from manual data entry.

This study is a cross-sectional study aimed at investigating the digital inclusiveness of smart elderly care initiatives led by the Beijing municipal government. The study population consists of elderly residents in Beijing. Considering the Chinese legal stipulation that "children have the obligation to support, care for, and provide emotional comfort to their parents," and the practical reality that some elderly individuals live with their children, Beijing residents with elderly family members are also included in the study (Standing Committee of the National People's Congress, PRC, 1996).

3.1.5 Sample Size Calculation

This study employs statistical methods such as regression analysis and factor analysis, therefore, the sample size is typically 10-20 times the number of items (Kyriazos, 2018;

Jackson, 2003). The questionnaire used in this study comprises 19 items, suggesting an initial sample size of 190 to 380 cases. However, considering the potential issue of response rate, an additional 10% has been added to the sample size. Therefore, the final required sample size is determined to be between 209 and 418 cases.

3.1.6 Research Participants

Inclusion Criteria:

- The respondent is aged 60 years or older, or has a family member aged 60 years or older who is under their care.
- Permanent residents of the communities (residing in Beijing for one year or more).
- Informed consent is given, and they voluntarily agree to participate in this study.

Exclusion Criteria:

- Individuals with severe cognitive impairment or mental disorders.
- Individuals who are deaf or have language communication disorders that prevent them from participating in the survey.

3.1.7 Survey Instrument

The survey instrument used in this study is the " Questionnaire on Factors Influencing Digital Inclusion in Government Led Smart Elderly Care Services." The questionnaire primarily consists of two sections:

(1) Basic information

This section includes items such as age, gender, residential district, years of education, and whether the individual had formal employment before retirement.

(2) Factors influencing digital inclusion in smart elderly care based on TAM

Based on the TAM and utilizing a literature review method, this study identifies the factors influencing digital inclusion in smart elderly care as led by the Beijing government. This section comprises six dimensions with a total of 19 items, specifically including Access (three items), Perceived Ease of Use (three items), Perceived Usefulness (three items), Skills (five items), Attitude towards Using (two items), and Usage (three items). Each item is measured on a five-point Likert scale, corresponding

to: "Strongly Agree" = 1 point, "Agree" = 2 points, "Neutral" = 3 points, "Disagree" = 4 points, and "Strongly Disagree" = 5 points.

The variables, research questions, and references are presented in the table below.

Latent Variables	**Questions**	**Reference**
Access (A)	I have access to mobile phones and data networks within my activity range. I have access to telephones and telephone signals within my activity range. If I desire, I can easily obtain smart elderly care devices or services.	Van Dijk (2017), Jun (2020)
Perceived Ease of Use (PEOU)	I would easily make smart elderly care devices or services serve me. I would easily learn how to operate smart elderly care devices or how to order smart elderly care services. My interactions with smart elderly care devices or services are clear.	Davis et al. (1989), Li et al. (2019)
Perceived Usefulness (PU)	Using smart elderly care devices and services would enhance my effectiveness in life. Using smart elderly care devices and services would make my life more convenient. I find smart elderly care devices and services useful in your life.	Davis et al. (1989), Moore and Benbasat (1991), Li et al. (2019)
Skills (S)	I can operate smart health monitoring devices (such as smart blood pressure monitors and other smart health monitoring equipment). I can operate smart safety monitoring devices (such as 'one-button emergency' smart devices). I can browse the internet on a smartphone. I can make phone calls. I can (in terms of knowledge and skills) assist others in using smart elderly care devices or in seeking smart elderly care services.	Van Dijk (2017), Zsuzsa Győrffy et al. (2023)
Attitude Towards Using (ATU)	Using smart elderly care devices or services is a good idea. I am willing to use smart elderly care devices or services.	Chen and Lou (2020)
Usage (U)	Using smart elderly care devices or services has reduced the stress in my life. Using smart elderly care devices or services has fulfilled my elderly care needs. I have enjoyed the convenience that using smart elderly care devices or services brings.	Van Dijk (2017)

Table 3.1 Variables, research questions, and references in *Questionnaire on Factors Influencing Digital Inclusion in Government Led Smart Elderly Care Services.*

The detailed content of the questionnaire can be found in Appendix A.

3.1.8 Pilot Survey and Reliability and Validity Testing

To ensure the reliability and validity of the questionnaire, a pre-survey was conducted by distributing 80 questionnaires before the formal investigation. SPSS 29.0 software was used to test the reliability and validity of six latent variables: Access, Perceived Ease of Use, Perceived Usefulness, Skills, Attitude towards Using, and Usage. The results indicated that the Cronbach's α coefficients for all dimensions were greater than 0.7, with an overall Cronbach's α coefficient of 0.851. The KMO value was 0.739, and Bartlett's Test of Sphericity yielded an Approx. Chi-Square of 882.800, with 71 degrees of freedom and a significance level of less than 0.001. These results demonstrate good reliability and validity of the questionnaire, with no variables needing removal.

3.1.9 Formal Survey

This study was conducted in May 2024 in collaboration with a social work service team in Beijing. This team aims to address the challenges faced by the elderly in integrating into the information society and has been carrying out "technology assistance for the elderly" community service activities in nearly fifty communities in Beijing. Due to practical considerations, the team members requested anonymity for their organization. The survey respondents are residents of the community served by the organization. The distribution and collection of questionnaires were facilitated through WJX, the most widely used online survey platform in mainland China. Respondents could complete the survey using mobile devices or computers. Additionally, to facilitate the participation of the elderly, social work service team staff would read the questionnaire contents to them and input their responses, ensuring that elderly participation was not limited by their ability to use mobile phones.

3.2 Qualitative Research

Quantitative research, with its ability to deduce results through numerical data, excels at uncovering behaviors and trends. However, quantitative research cannot address the motivations behind people's actions, such as why individuals make certain decisions (Goertzen, 2017). Therefore, it is necessary to incorporate qualitative research methods.

3.2.1 Research Method: Semi-structured Interview

This study employed a semi-structured interview qualitative research method. Semi-structured interviews are used to gather opinions on key topics or to collect background

information and institutional perspectives from key informants (Hammarberg et al., 2016).

Compared to other qualitative research methods such as written surveys, the advantage of interviews lies in their interactivity, allowing unexpected topics to emerge and be adopted by the researcher (Corbin & Morse, 2003).

In contrast to unstructured interviews, semi-structured interviews utilize an interview guide to provide structure and focus for each unique interview, facilitating a natural and smooth conversation with the interviewee (Adeoye-Olatunde & Olenik, 2021). The interview guide mainly consists of open-ended questions and follow-up probes designed to address the research objectives, which the interviewer can refer to throughout the interview process (Adeoye-Olatunde & Olenik, 2021).

3.2.2 Research Participants

Effective smart elderly care services rely on the direct involvement of two primary groups: service recipients (the elderly and their families) and service providers (in the context of this study, community elderly care service centers). Therefore, this research involves conducting separate interviews with these two groups. The detailed information of participants in the semi-structured interviews for this study is as follows:

Number	Category	Interview Time	Remarks
E1	Elderly and families	18.04.2024	Elderly lady (72 y.o.) living with only son in Chaoyang District
SB	Service supplier	22.04.2024	Class B elderly service center located in Changping District; the respondent was an assistant to center manager.
E2	Elderly and families	25.04.2024	Parents (65+ y.o.) living in Shunyi District, children visit on weekends
SC	Service supplier	06.05.2024	Class C elderly service center located in Changping District; the respondent was center manager.
E3	Elderly and families	13.05.2024	Parents (70+ y.o.) living in Xicheng District, with one daughter living in the same neighborhood.
SA	Service supplier	14.05.2024	Class A elderly service center located in Shijingshan District; the respondent was center manager.

Table 3.2 Research participants

For the recipients of smart elderly care services (elderly residents of Beijing and their families), I personally visited the communities served by the social work service team, engaged in conversations with the elderly and their families, and requested interviews with them. I also indicated at the end of the questionnaire (used for quantitative analysis) the intention to interview the elderly and their families who completed it. Through further communication and coordination, I selected elderly individuals and their families from three different districts in Beijing to participate in the interviews.

For the providers of smart elderly care services (staff members of community elderly care service centers), I contacted three community elderly care service centers of different scales (categorized as A, B, and C according to the classification by Beijing Municipal Civil Affairs Bureau (2021)) via phone and social media. Social workers or directors from these centers agreed to participate in the interviews.

Additionally, I attempted to interview relevant government officials but was politely declined and directed to refer to the government portal for detailed information. The operational information (such as the number of service users and service projects) of the "Beijing Elderly Care Service Website" is classified under "information disclosure upon request." I submitted an information disclosure application to the supervising unit of the website and received a written response from the Beijing Civil Affairs Bureau.

3.2.3 Interview Guide

In this study, distinct interview guides were developed for the receivers and suppliers of smart elderly care services, specifically targeting elderly individuals and their family members, and staff at community elderly care service centers.

The interview guide for elderly individuals and their family members was designed with reference to van Dijk's (2002) categorization of the digital divide in terms of access, skills, and usage. This guide includes questions related to the current availability of smart elderly care devices, services, and comprehensive information websites in Beijing, aiming to assess their level of understanding, demand, utilization, using preference, concerns and evaluation of these service.

The interview guide for elderly and their families is shown in the table below.

Service recipients: elderly and their families	
Key words	**Questions**
Access of smart device	What digital products do you currently own (such as

	smartphones, tablets, smart wearable devices, etc.)?
	Who purchased these devices for you?
User experience of smart devices	How has your experience been in using them?
Digital skills	What difficulties do you encounter in using the internet and digital products?
	Have you ever interrupted digital life services operations due to usage barriers?
Level of understanding of smart elderly care services	Are you familiar with smart home-based elderly care services?
	Are you familiar with the Beijing Elderly Care Service Website?
Demand for smart elderly care services	What do you think are the most needed services in smart elderly care?
User experience of smart elderly care service	What services have you used?
Perceived usefulness of smart elderly care / Perceived ease of use of smart elderly care	How do you feel about these smart elderly care services?
	Have they improved or enriched your quality of life in retirement, or have they made your life more difficult?
	What factors contribute to your perception of these services as useful or not?
	(On the Beijing Elderly Care Service Website) what services do you find useful and helpful?
Usage preference (online/offline)	If these services have offline application methods, would you prefer online or offline?
Usage concerns	What concerns do you have about the smart elderly care service platform?
	Are there any specific needs you have that this platform could address?
Usage expectations	Are there any services you think the Beijing Elderly Care Service Website could offer? (If you do not need this service platform, why not?)
	Do you have any good suggestions for improving the development of the smart elderly care service platform?

Table 3.3 Interview guide for service recipients: elderly and their families

For the staff at community elderly care service centers, the interview guide focuses on the types, forms, scale, and effectiveness of the (smart) elderly care services they provide. The objective is to gain insights from practitioners regarding the current state of the smart elderly care industry.

The interview guide for staff of community elderly care service centers is shown in the table below.

Service providers: staffs of community elderly care service centers	
Key words	**Questions**
Supply of smart services/devices	What types of smart elderly care services have you implemented in your elderly care service center?
	What smart elderly care devices have you provided to the residents?
Service scale	How many elderly people can benefit from these smart elderly care services?
Level of understanding of smart elderly care services	What is your ideal vision of smart elderly care services?
Service expectations	How do you evaluate the current level of smart elderly care services?
Satisfaction	How do the elderly who receive smart elderly care services and their families evaluate the services provided by the government?
Existing problems	What specific challenges do you think smart elderly care services currently face?
	What do you think are the specific reasons for these challenges?
Improvement methods	Do you have any good suggestions for development?
Service promotion	How does your service center integrate into the Beijing elderly care service website?
	How do you promote it to the elderly and their families?
	What affects the elderly's usage of these services?
Supplementary explanation	In the course of your actual work, what impressive events have occurred?
	What problems have you encountered?
	How were these problems solved, and which ones are difficult to solve?

Table 3.4 Interview guide for service providers: staffs of community elderly care service centers

All six interviews were conducted via video conferencing in April and May 2024.

4 Analysis

In this chapter, I analyze the results obtained from the questionnaire survey and interviews discussed in the previous chapter.

For the quantitative data gathered from the questionnaire survey, I performed data cleaning and conducted descriptive statistics, correlation analysis, reliability analysis, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and structural equation modeling (SEM) using SPSS 29.0 and Amos 26.0 software.

For the textual data obtained from the interviews, I used Nvivo 14 software to conduct coding. This process allowed me to systematically identify the current state, existing issues, and suggestions for improvement in the development of smart elderly care led by the Beijing municipal government, thereby preparing for addressing the research questions of this study in the next chapter.

4.1 Quantitative Analysis

4.1.1 Data Collection and Preprocessing

This study collected questionnaire samples via the internet in May 2024, resulting in a total of 355 collected questionnaires, with a 100% response rate. After data preprocessing, 43 invalid questionnaires were removed, leaving 312 valid questionnaires, yielding an effective response rate of 87.9%. The data processing involved manual verification according to the questionnaire logic (for example, Question 6: "Please answer based on your actual situation: I have used: (Multiple Choices)" If a respondent selected the last option, "I have not used any of the above," while also selecting any choice of the first three smart elderly care devices or services, it was considered a contradictory response, rendering the questionnaire invalid). Additionally, questionnaires with a completion time of less than 60 seconds were deleted. The questionnaire was administered through an online survey platform, and all questions were mandatory. Therefore, the collected data contains no missing values or outliers.

4.1.2 Descriptive Statistics

After the preprocessing stage of the questionnaire, a statistical analysis of respondents' demographic information is firstly conducted based on the questionnaire's structure. This step falls under the category of descriptive statistics. By performing descriptive statistics, the characteristics of the respondents can be determined through measures

such as counts, proportions, medians, and means. This analysis helps verify the representativeness of the respondents, ensuring that the collected data is not overly biased and accurately reflects the overall population.

The table below summarizes the demographic information of 312 respondents who submitted valid questionnaires. It includes data on the respondents' age, gender, residential district (in Beijing), years of education, and employment status before retirement. The table also provides the number of respondents and the proportions for each category, based on the options provided in the questionnaire.

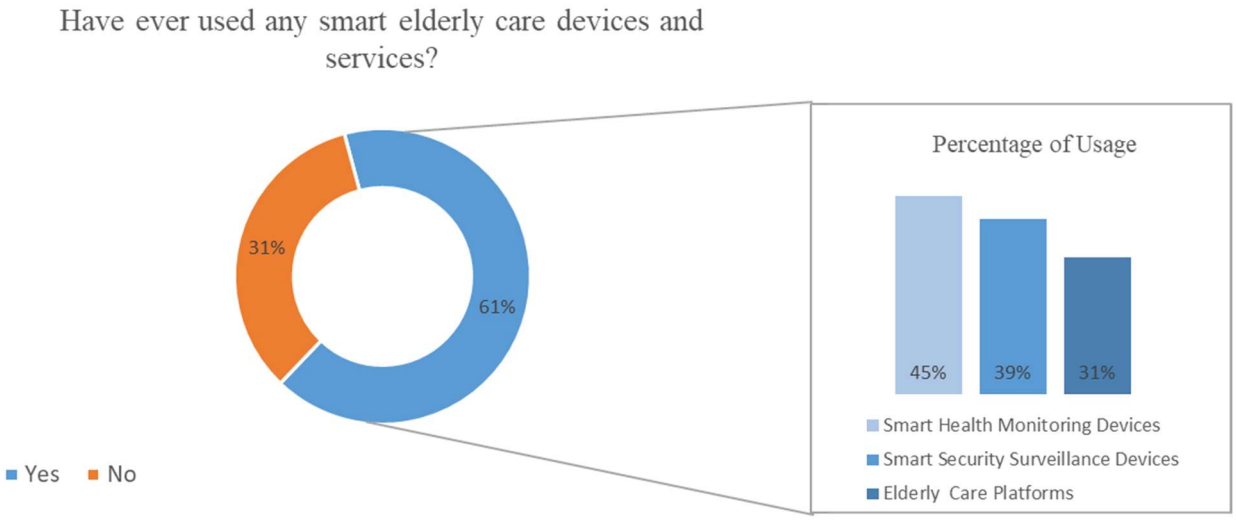
	Amount	Ratio
Age		
60-64 years old	56	18%
65-69 years old	78	25%
70-74 years old	74	24%
75-79 years old	68	22%
80 years old and above	36	12%
Gender		
Male	151	48%
Female	161	52%
Residential District (in Beijing)		
Central Six Districts	174	56%
Other administrative Districts (Suburbs)	138	44%
Years of Education		
No formal Education	39	13%
1-6 years	70	22%
7-9 years	102	33%
More than 9 years	101	32%
Employment Status Before Retirement		
Yes	189	61%
No	123	39%
Total	312	100%

Table 4.1 Demographics of respondents

Based on the statistics in the table, it is evident that approximately 70% of the respondents are aged between 65 and 79. The gender ratio is 48:52, indicating a relatively balanced distribution between male and female respondents. Regarding residential areas, about 56% of the respondents (174 individuals) currently reside in Beijing's Central Six Districts (Dongcheng District, Xicheng District, Chaoyang District, Haidian District, Fengtai District, and Shijingshan District) while 44% respondents reside in suburb administrative districts. This distribution closely mirrors the spatial population distribution of Beijing (Beijing Municipal Bureau of Statistics, 2023). In terms of years of education, over 60% of the respondents have received 7 years or more

of education. Furthermore, among the respondents, 61% were employed before retirement.

Regarding the actual use of smart elderly care devices and services, 139 respondents indicated they had used smart health monitoring devices such as smart blood pressure monitors, and 123 respondents had used smart security surveillance devices like One-touch emergency systems. Additionally, 96 respondents had utilized digital platforms providing elderly care services. Furthermore, 121 respondents, representing 39%, stated they had never used any of the smart elderly care devices or services mentioned in the questionnaire.



Source: Survey result

Figure 4.1 Usage distribution of smart elderly care devices and services among respondents

4.1.3 Correlation Analysis

In social sciences, correlation analysis provides a statistical method to explore whether there is an association between variables, as well as the strength and direction of this association (Schober et al., 2018). Correlation analysis not only helps researchers identify potential relationships between variables but also serves as a starting point for further causal relationship studies (Senthilnathan, 2019). The degree of correlation is often expressed through the correlation coefficient, which ranges from -1 to +1, where +1 indicates a perfect positive correlation, 0 indicates no correlation, and -1 indicates a perfect negative correlation (Schober et al., 2018).

As mentioned above, in this study, each item is measured using a Likert five-point scale, ranging from 1 to 5, which is referred to as an ordinal scale, representing ordered categorical data. Therefore, compared to Pearson's correlation coefficient, Spearman's rank correlation coefficient is more appropriate for conducting the correlation analysis in this study (Thirumalai et al., 2017). The analysis results are presented in the following table.

Correlations: Spearman's rho						
	A	S	PU	PEOU	ATU	U
A	--					
S	-.102	--				
PU	.242**	.096	--			
PEOU	.279**	.015	.289**	--		
ATU	.361**	.134*	.249**	.267**	--	
U	.162**	.037	.048	.035	.283**	--
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

Table 4.2 Correlations analysis: Spearman's rho

Based on the results in the table and in conjunction with the research model of this study, it can be observed that the research hypotheses H1, H2, H3, H5, H6, and H7 are supported, validating the relationships between the variables. Access (A) significantly impacts Perceived Ease of Use (PEOU) and Perceived Usefulness (PU). PEOU significantly affects PU, and both PU and PEOU significantly influence Attitude Toward Using (ATU). Additionally, ATU has a significant impact on Usage (U). The research hypothesis H4 involves a moderating effect, which cannot be directly assessed using the Spearman's rank correlation coefficient alone and requires further statistical analysis.

4.1.4 Reliability Analysis

Reliability testing is an assessment of the similarity of questionnaires, effectively evaluating their reliability and stability. Additionally, reliability testing serves as a prerequisite for conducting tests such as difference testing, correlation analysis, and regression analysis. Questionnaire reliability is generally measured using Cronbach's Alpha, where a higher coefficient indicates greater reliability of the questionnaire, implying higher credibility and stability (Taber, 2018). A Cronbach's Alpha greater than 0.7 is considered relatively reliable (Taber, 2018).

Similar to Cronbach's Alpha, composite reliability (CR) is a method used to assess the internal consistency of latent variables, particularly suitable for Structural Equation Modeling (SEM) (Bacon et al., 1995). Composite reliability can measure the internal consistency of the measurement model and evaluate the reliability of constructs. Generally, a CR greater than 0.7 indicates good internal consistency and reliability of the model (McHorney & Tarlov, 1995).

	A	S	PEOU	PU	ATU	U	Overall Scale
Cronbach's Alpha	0.790	0.872	0.858	0.874	0.829	0.844	0.792
CR	0.798	0.873	0.876	0.859	0.830	0.846	0.898

Table 4.3 Reliability testing: Cronbach's alpha and composite reliability (CR)

From the table above, both the Cronbach's Alpha and CR of the questionnaire exceed 0.7, indicating that the questionnaire has a good reliability value. This allows for subsequent factor analysis to be conducted.

4.1.5 Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis (EFA) is a statistical method used to identify and interpret the interrelationships among explanatory variables within a dataset (Shrestha, 2021). It aims to reduce dimensionality by extracting latent factors from observed variables and effectively grouping these variables to identify underlying structures and patterns within the data (Shrestha, 2021).

Before conducting factor analysis, it is essential to analyze the validity of the questionnaire. Validity refers to the degree to which a questionnaire or measurement tool accurately and appropriately measures the intended concept (Pallant, 2020). While reliability analysis focuses on the internal consistency of the questionnaire, validity analysis is used to determine whether the questionnaire accurately measures the constructs that the researcher intends to measure (Pallant, 2020).

Questionnaire validity is typically assessed using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity (Pallant, 2020). The KMO value measures the ratio of partial correlation coefficients to overall correlation coefficients (Pallant, 2020). Bartlett's Test of Sphericity examines whether the correlation matrix of observed variables is an identity matrix; if it is an identity matrix, factor analysis is not appropriate. Generally, a KMO value greater than 0.7 and a significance level (Sig.) of

less than 0.05 in Bartlett's Test of Sphericity are considered indicators of good questionnaire validity (Pallant, 2020).

The results of the KMO test and Bartlett's Test of Sphericity are shown in the table below.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.796
Bartlett's Test of Sphericity	Approx. Chi-Square	2748.701
	df	171
	Sig.	<.001

Table 4.4 Validity analysis: KMO and Bartlett's test

The KMO value for this questionnaire is 0.796, and the significance level of Bartlett's Test of Sphericity is less than 0.001. These results indicate that the data are suitable for conducting factor analysis.

Factor analysis requires extracting factors from the data. SPSS software can be used to extract initial eigenvalues, recalculate the variance explained by each factor (extraction sums of squared loadings), and compute the rotation of squared loadings using specific methods (such as Varimax and Promax). The output results of this study are shown below.

Total Variance Explained									
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.176	21.980	21.980	3.745	19.711	19.711	2.934	15.443	15.443
2	3.394	17.863	39.844	2.865	15.080	34.791	2.131	11.214	26.657
3	2.385	12.555	52.399	2.094	11.022	45.813	2.055	10.813	37.471
4	1.721	9.060	61.459	1.422	7.484	53.297	1.993	10.489	47.959
5	1.515	7.974	69.433	1.109	5.836	59.133	1.765	9.289	57.248
6	1.106	5.820	75.253	1.024	5.390	64.522	1.382	7.274	64.522
7	.548	2.883	78.135						
8	.504	2.654	80.789						
9	.430	2.263	83.052						
10	.402	2.118	85.170						
11	.396	2.085	87.255						
12	.372	1.960	89.215						
13	.361	1.902	91.117						

14	.332	1.747	92.865						
15	.321	1.692	94.556						
16	.277	1.457	96.013						
17	.264	1.389	97.402						
18	.256	1.349	98.751						
19	.237	1.249	100.000						
Extraction Method: Maximum Likelihood.									

Table 4.5 Exploratory factor analysis: total variance explained

The initial eigenvalues are used to determine the number of factors, with factors having eigenvalues greater than 1 typically considered significant. As shown in the table above, the first six factors were initially extracted using the Maximum Likelihood method. Under "Initial Eigenvalues," these six factors have a Variance Extraction Ratio (VER) ranging from a high of 21.980% to a low of 5.820%, cumulatively explaining 75.253% of the variance. After applying the Varimax rotation method, the explained variance is more evenly redistributed among the six factors, with the highest VER being 15.443% and the lowest being 7.274%, cumulatively explaining 64.522% of the variance. In the field of social sciences, a cumulative variance explanation of 60% to 70% is generally considered acceptable.

Additionally, the Varimax rotation method results in a clearer factor loading pattern, as shown in the table below.

Rotated Factor Matrix[a]						
	Factor					
	1	2	3	4	5	6
A1					.687	
A2					.741	
A3					.740	
S1	.729					
S2	.807					
S3	.778					
S4	.754					
S5	.725					
PU1			.764			
PU2			.809			
PU3			.819			
PEOU1		.827				
PEOU2		.840				
PEOU3		.775				

ATU1						.876
ATU2						.690
U1				.804		
U2				.807		
U3				.776		
Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization.						
a. Rotation converged in 5 iterations.						

Table 4.6 Exploratory factor analysis: rotated factor matrix

	Communalities[a]
	Extraction
A1	.548
A2	.592
A3	.594
S1	.544
S2	.657
S3	.618
S4	.588
S5	.532
PU1	.625
PU2	.713
PU3	.687
PEOU1	.743
PEOU2	.727
PEOU3	.662
ATU1	.860
ATU2	.610
U1	.661
U2	.673
U3	.626
Extraction Method: Maximum Likelihood. a. One or more communalitiy estimates greater than 1 were encountered during iterations. The resulting solution should be interpreted with caution.	

Table 4.7 Exploratory factor analysis: communalities

The tables present the factor loadings of each latent variable after rotation. The data indicates that all communalities for the research items are higher than 0.4, signifying a strong correlation between the research items and the factors (Pallant, 2020). This implies that the factors can effectively extract the underlying information.

4.1.6 Confirmatory Factor Analysis (CFA)

Exploratory Factor Analysis (EFA) is data-driven and primarily used to explore the underlying structure of the data, while Confirmatory Factor Analysis (CFA) is theory-driven and used to validate whether these structures are reasonable and stable (Pallant, 2020). In the previous section, EFA extracted six factors; thus, it is necessary to further confirm through CFA whether the extracted factors meet the construct validity. Specifically, this includes convergent validity analysis and discriminant validity. This study will examine the data from these two aspects.

Average Variance Extracted (AVE) is a method for assessing the convergent validity of latent variables (Pallant, 2020). It measures the average amount of variance that a latent variable explains in its measured indicators. After calculation, the CR and AVE values for each variable and the overall scale in this study are as follows.

	A	S	PEOU	PU	ATU	U	Overall Scale
CR	0.798	0.873	0.876	0.859	0.830	0.846	0.898
AVE	0.568	0.579	0.703	0.670	0.709	0.647	0.634

Table 4.8 Convergent validity analysis: CR and AVE

In the previous sections, the CR values for this study have been evaluated, all of which exceed 0.7, indicating good internal consistency and reliability of the constructs. Regarding AVE, it is generally accepted that an AVE value higher than 0.5 signifies good convergent validity of the constructs (Cheung et al., 2023). Therefore, this study demonstrates good convergent validity.

	A	S	PU	PEOU	ATU	U
A	0.754					
S	-.102	0.761				
PU	.242**	.096	0.819			
PEOU	.279**	.015	.289**	0.838		
ATU	.361**	.134*	.249**	.267**	0.842	
U	.162**	.037	.048	.035	.283**	0.804
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

Table 4.9 Discriminant validity analysis

The table above demonstrates the discriminant validity of the constructs in this study. Through analysis, the diagonal values (i.e., the square roots of the AVE values in this study) are: 0.754, 0.761, 0.819, 0.838, 0.842, and 0.804. Each diagonal value is greater than the values in the same column, indicating good discriminant validity of the constructs in this study.

4.1.7 Moderation Hypothesis Testing

For the moderation effect of S on the relationship between PEOU and PU in Hypothesis 4, an interaction term with the independent variable can be added to construct and compare two regression models. The data in the table below were calculated using SPSS and the PROCESS macro.

	(1) PU	**(2) PU**
(Intercept)	2.677***	3.647***
	(0.192)	(0.048)
PEOU	0.278***	0.275***
	(0.053)	(0.053)
S		0.110
		(0.059)
PEOU*S		0.114
		(0.064)
R^2	0.081	0.099
Adj. R^2	0.078	0.090
Num. obs.	312	312

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4.10 Moderation hypothesis testing: regression models

Evaluating the moderation effect requires examining the significance of the interaction term and comparing the change in R^2. In model (2) shown in the table, the coefficient for the interaction term PEOU * S is 0.114, with a standard error of 0.064, a t-value of 1.779, and a p-value of 0.076. Although the interaction term's coefficient is positive, its p-value of 0.076 is greater than 0.05, indicating that it does not reach the level of statistical significance. This suggests that, at the 95% confidence level, the moderating effect of Skills Acquisition (S) on the relationship between Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) is not significant.

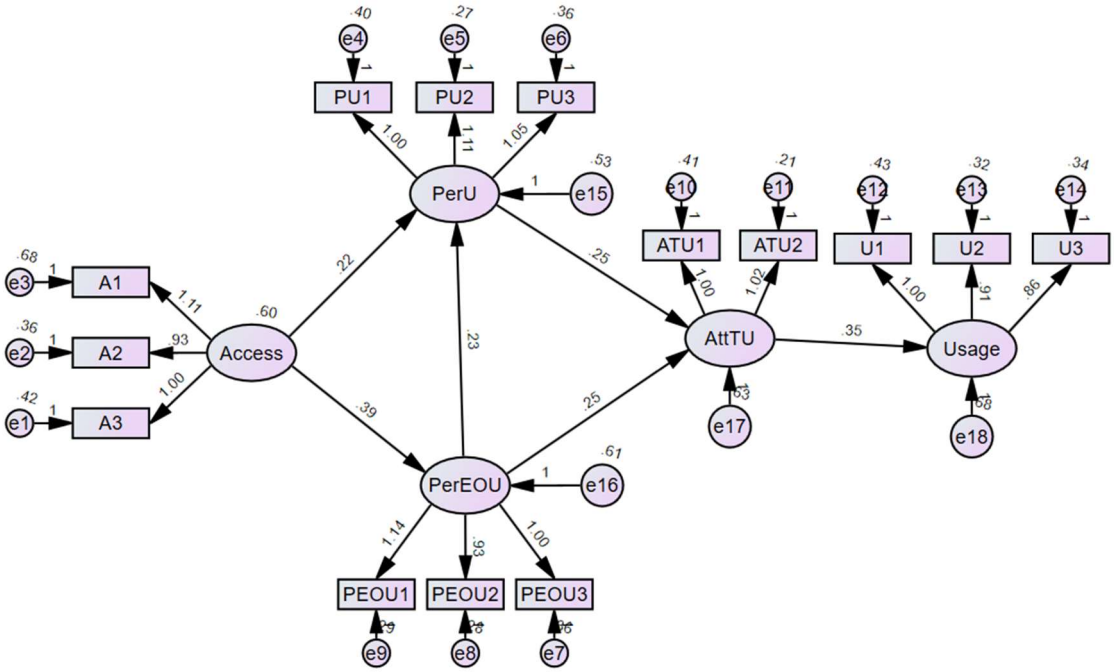
Additionally, the R^2 for model (1) is 0.081, while the R^2 for model (2) is 0.099. The R^2 for model (2) increases by 0.018 compared to model (1), indicating that adding Skills

Acquisition (S) and the interaction term increases the model's ability to explain the variance in Perceived Usefulness (PU) by 1.8%. This increase is less than 5%, suggesting that the explained variance in this hypothesis is not substantial.

Moreover, although not statistically significant, the positive coefficient of the interaction term suggests that Skills Acquisition (S) may enhance the effect of Perceived Ease of Use (PEOU) on Perceived Usefulness (PU). However, considering the overall findings, Hypothesis 4 is rejected.

4.1.8 Structural Equation Modelling (SEM) Analysis

Unlike traditional multiple regression analysis, Structural Equation Modeling (SEM) can handle multiple equations simultaneously, allowing researchers to estimate the relationships between multiple dependent and independent variables concurrently (Blunch, 2012). In this study, all research hypotheses except H4 were tested using SEM analysis conducted in the Amos software. Amos supports the intuitive and straightforward construction of research models and the linking of data for computation. Additionally, Amos provides various model fit indices to evaluate the goodness-of-fit of the model.



Source: Amos

Figure 4.2 AMOS structural equation model diagram

Fit Index	Definition	Acceptable Range	Result	Evaluation
GFI	Goodness of Fit Index	> 0.90	0.963	Good
AGFI	Adjusted Goodness of Fit Index	> 0.90	0.946	Good
RMR	Root Mean Square Residual	< 0.08	0.063	Good
RMSEA	Root Mean Square Error of Approximation	< 0.08	0.025	Good
NFI	Normed Fit Index	> 0.90	0.958	Good
IFI	Incremental Fit Index	> 0.90	0.993	Good
CFI	Comparative Fit Index	> 0.90	0.993	Good

Table 4.11 SEM analysis: evaluation of model fit analysis results

The table above shows the fit indices of the structural equation model after modeling the research data. As can be seen, all the indices are evaluated as "Good," indicating that the model is well-constructed and suitable for path analysis.

			Estimate	S.E.	C.R.	PLabel
PerEOU	<---	Access	.387	.075	5.189	***
PerU	<---	Access	.222	.074	3.025	.002
PerU	<---	PerEOU	.232	.065	3.563	***
AttTU	<---	PerU	.246	.076	3.225	.001
AttTU	<---	PerEOU	.250	.071	3.501	***
Usage	<---	AttTU	.354	.070	5.057	***
***: less than .001						

Table 4.12 SEM analysis: path analysis

Based on the table 4.11, it can be seen that:

- A has a significant positive impact on PEOU (path coefficient greater than 0), with a coefficient of 0.387 and a p-value less than 0.001, thus Hypothesis 1 is supported.

- A has a significant positive impact on PU (path coefficient greater than 0), with a coefficient of 0.222 and a p-value of 0.002, thus Hypothesis 2 is supported.
- PEOU has a significant positive impact on PU (path coefficient greater than 0), with a coefficient of 0.232 and a p-value less than 0.001, thus Hypothesis 3 is supported.
- PU has a significant positive impact on ATU (path coefficient greater than 0), with a coefficient of 0.246 and a p-value of 0.001, thus Hypothesis 5 is supported.
- PEOU has a significant positive impact on ATU (path coefficient greater than 0), with a coefficient of 0.250 and a p-value less than 0.001, thus Hypothesis 6 is supported.
- ATU has a significant positive impact on U (path coefficient greater than 0), with a coefficient of 0.354 and a p-value less than 0.001, thus Hypothesis 7 is supported.

Therefore, in this study, all hypotheses are supported except for the moderation effect hypothesis (Hypothesis 4), which is not supported.

4.2 Qualitative Analysis

Qualitative data, such as data collected from interviews, is typically subjective and rich, containing in-depth information usually presented in textual form (Wong, 2008). Based on six semi-structured interviews conducted between April and May 2024, the recordings were first transcribed. As the interviews were conducted in Chinese, the transcripts were then translated into English, as detailed in Appendix B and C.

4.2.1 Coding

To handle quantitative data, coding is considered an effective means of segmenting large amounts of raw information or data and then assigning it to categories (Wong, 2008). Codes are labels or markers used to assign identified themes or topics from the compiled data in a study (Wong, 2008). Nowadays, qualitative researchers increasingly use electronic methods for data coding, with NVivo software becoming a primary tool for this process (Wong, 2008).

This analysis refers to the keywords from the interview guide in section 3.2.3 and applies them during the coding of the interview transcript. Additionally, due to the inherently interactive and uncertain nature of interviews, multiple codes can be

applicable to a single response from an interviewee. The statistics on the number of coding references derived from NVivo are presented in the following two tables.

Service recipients: elderly and their families	
Code	**Reference**
Access of smart device	5
Demand for smart elderly care services	6
Digital skills	6
Level of understanding of smart elderly care services	8
Perceived usefulness of smart elderly care / Perceived ease of use of smart elderly care	3
Usage concerns	5
Usage expectations	18
Usage preference (online/offline)	3
User experience of smart devices	4
User experience of smart elderly care service	3

Table 4.13 Transcript coding: interview with elderly and their families

Service providers: staffs of community elderly care service centers	
Code	**Reference**
Existing problems	18
Improvement methods	1
Level of understanding of smart elderly care service	6
Satisfaction	3
Service expectations	4
Service promotion	5
Service scale	6
Supplementary explanation	4
Supply of smart services or devices	10

Table 4.14 Transcript coding: interview with staffs of community elderly care service centers

4.2.2 Text Analysis: Service Recipients

Despite the widespread penetration of digitalization across various sectors in China, there is significant individual variation in whether elderly individuals use digital devices, as well as their motivations for using specific types of digital devices. During the

interviews, when discussing smart devices, the most frequently mentioned device was the mobile phone. Most of the elderly respondents use smartphones, typically purchased by their children. However, some elderly individuals, due to age and health conditions (being bedridden), have only used simple phones for making and receiving calls or are no longer using them.

In addition to mobile phones primarily used for communication, other frequently mentioned smart devices include health monitoring equipment such as smart blood pressure monitors and smart oximeters. The outbreak of pandemic has heightened the awareness of health indicators among the elderly and their families, increasing the demand for convenient daily monitoring. This has objectively promoted the adoption of smart health devices in households. These devices were purchased by the elderly individuals' children based on the health needs of the elderly. The respondents generally reported finding these devices very convenient to use.

“We have a commonly used oximeter at home, which I bought during the pandemic. It's quite advanced; I can check each recorded value on my phone app, so there's no need to write it down on paper.” (E1)

“There's also a smart device for monitoring blood pressure and heart rate…overall, the usage effect is quite good. The monitoring devices are generally accurate and more convenient than going directly to the hospital for checks.” (E2)

However, in the actual use of these digital devices, respondents indicated that elderly individuals still encounter difficulties due to their physical limitations (such as vision levels, finger dexterity, and the clarity of their fingerprints), leading to usage inefficiencies. This reflects that many devices and technologies were not adequately designed with the usage characteristics of the elderly in mind, lacking elderly-friendliness.

“Even with a smartphone in "elderly mode," the individual buttons are still too small, making it easy to press the wrong ones.” (E3)

“Additionally, some elderly people's fingerprints are not very clear, which makes fingerprint unlocking or recording fingerprints a bit difficult.” (E3)

Additionally, in the operation and use of some apps, elderly individuals may face more challenges and confusion compared to other demographic groups.

“The main difficulties are mainly with the phone and these apps, as the service guides for the elderly are not very comprehensive. Some apps might be difficult for the elderly

to use, and some do not have large font versions or simplified versions, so I think this needs improvement. Additionally, the operation manuals for some devices might not be easy for the elderly to understand." (E2)

"Due to a lack of understanding of digital products, they sometimes press the wrong buttons, leading to interruptions or switching services." (E2)

From the above, although the use of smart devices may encounter certain obstacles and limitations, the elderly families interviewed all have some involvement with these devices. Smart devices play varying roles in the elderly's lives, contributing to their care and daily activities to different extents. Interviews also revealed that in these households, technical assistance from family members is crucial for elderly individuals using smart devices. Help from family members often resolves the elderly's issues in the shortest time possible.

Regarding the concept of smart elderly care, respondents are not entirely unfamiliar with it. One respondent is able to accurately articulate the essence of smart elderly care:

"Basically, it (smart elderly care) involves using digital technology, including the Internet of Things (IoT) smart devices, to provide more convenient home-based elderly care services. That's my understanding."(E2)

Some respondents, although limited in their understanding of the concept, can imagine the extension of smart elderly care based on their life experiences, their needs for elderly care services, and the introduction from others (such as grassroots community staffs).

"I have heard about it. I am relatively in touch with the community, and the community staff introduced it to me. The community provides my mother with a monthly care allowance of 300 yuan based on her condition. I regularly hire a caregiver to come home and help her bathe… (Do you call the community to make an appointment each time or place an order online?) I directly call the caregiver. I always use the same caregiver, and we are quite familiar with each other" (E1)

"I have heard about smart home-based elderly care services. What I really need is a 24-hour service that can keep track of the elderly's condition at all times. Sometimes, even I cannot know what the elderly are doing or if they are in danger. I especially hope for a service person who can help me check on the elderly when I am unable to, and provide timely assistance if needed…I haven't specifically used them; this is just my idea. I've only heard a bit about it from others." (E3)

In terms of the use of smart elderly care services, according to the reports of the respondents in this study, Respondent E1 who used bathing assistance services for a bedridden mother, another respondent, Respondent E2, stated, "*have tried ordering meals and having them delivered*." Both instances involve life assistance elderly care services provided at the community elderly care service centers, which are led by the Beijing municipal government.

For the two respondents who have experience using smart elderly care services, both hold positive evaluations of these services. They believe that these services are effective and meet their needs for saving time and effort. However, they still expect further improvement in the standardization of elderly care services. The popularity of elderly care services in society also positively influences the acceptance among the elderly and the family.

"I think it's (smart elderly care service) pretty good… My leisure time is mostly spent taking care of my mother. If these services can really help me, save me some effort and time, then I would find them useful." (E1)

"I think if the development can become more standardized and reassuring, it can certainly be more convenient, and we can save a lot of energy spent on this." (E2)

"I think the number of participants would affect me (the idea thinking these services helpful or not). If there are too few participants, I wouldn't feel very confident in trying it out." (E2)

Respondent E3, who has not yet had any experience with using smart elderly care services, is also interested in accessing government-led smart elderly care services, particularly safety monitoring devices or services. However, Respondent E3 expressed dissatisfaction with the promotion of these services at the street-level government.

"My street community says they occasionally organize care activities or visit the elderly periodically, but I haven't really felt the impact of this (promotion). For example, I'm not very clear on what services the community can provide for elderly care. I think the promotion might not be very effective. If I don't actively seek out information, there is no proactive introduction." (E3)

According to their words, the process of obtaining elderly care, which is a basic social welfare, some individuals have already been (intentionally or unintentionally) excluded, although the true reasons are unknown.

In 2023, the Beijing municipal government launched the Beijing Elderly Care Service Website, which provides citizens with online access to elderly care resources throughout the city and supports online ordering of these services. This website allows all residents of Beijing who require elderly care services to register and utilize.

However, according to the interview results, the popularity of the website is currently very limited. One respondent had never heard of the website, and those who had heard of it had not yet used the services provided on the website.

In this part of interviews, I also inquired about the respondents' preferences for the mode of accessing smart elderly care services (online or offline). The respondents showed different inclinations towards online or offline services based on various motivational considerations. Besides the convenience of use, respondents place great importance on the provision of information related to elderly care services. In this regard, both online and offline methods of obtaining information have their own advantages.

“I think both online and offline options are fine. Online might be more convenient. Offline (elderly care service) applications at the community level shouldn't be too difficult and complex.” (E2)

“Both online and offline options are fine. I haven't used it, but I would like to check it out. If it's like a shopping platform where I can compare prices and read reviews, that would be great. The main thing is that for elderly care services, the descriptions are usually very similar, and I care a lot about the reputation (of caregivers).” (E1)

“I prefer offline. You can't see the person you're dealing with online, which makes me uneasy. If it's offline, I can also ask for more details and feel more at ease when signing a contract.” (E3)

Despite respondents' overall open and welcoming attitude towards smart elderly care services, they still have concerns about potential issues, particularly regarding the digital platforms for elderly care services. These concerns mainly focus on the potential lack of oversight by relevant authorities in elderly care services and inadequate protection of individual privacy.

“My main concern is the lack of sufficient regulation. Although the government has set up this website (Beijing Elderly Care Service Website), if they don't review the institutions listed in the system, I would be very worried.” (E2)

“I just hope I won't be targeted by "big data price discrimination." Like on those online shopping platforms, the more you look, the more they know what you want, and the prices go up. If that's the case, I'd rather call someone directly and pay when they come to the door.” (E1)

For the future development of smart elderly care services, respondents offered several suggestions. These mainly focused on improving the convenience of accessing elderly care services, enhancing the trustworthiness of the services, and making the prices more reasonable.

“I hope the website can be as simple as possible in design so that the elderly can easily log in and choose the services they need. This way, we can feel more assured when we are not able to take care of them.” (E3)

“It doesn't necessarily mean subcontracting to social institutions; it should also involve some government participation. I hope the government, as a more trustworthy entity, can play a role in the elderly care network.” (E2)

“Also, I hope the service prices are more affordable. (E1)”

Based on the results presented in this section, the recipients (the elderly and their families) of elderly care services in Beijing have a significant demand for these services. Although most people are currently in a wait-and-see state regarding smart elderly care, they generally hold an open attitude towards such services. If their concerns about smart elderly care can be effectively addressed, the elderly and their families are willing to try these services.

4.2.3 Text Analysis: Service Suppliers

The government-led providers of smart elderly care services, namely the community elderly care service centers in Beijing, are categorized into three types (A, B, and C) based on their area, number of facilities, and service functions (Beijing Municipal Civil Affairs Bureau, 2021). Type A centers are the largest and most comprehensive, followed by Type B, and Type C centers are the smallest (Beijing Municipal Civil Affairs Bureau, 2021).

In this section of the interviews, social workers or directors from each of the three types of elderly care service centers introduced their respective services, which are mainly divided into two categories: in-center care and home care services (including offering meals, bathing assistance, cleaning assistance, etc.). The range of elderly care services provided by the A, B, and C type elderly care service centers gradually decreases.

“You can find us by searching the "Beijing Elderly Care Service Website." You can place orders online or call our center for services like home nursing, meal delivery, or bathing assistance. We also have online consultation services with the community health service center.” (SB)

“Our elderly care service center provides day care as well as full-time care for the elderly. It can be short-term or long-term care. Families can place their elderly here, and we take care of their food, accommodation, and care needs. For day care, we provide them with a bed; it's similar to a kindergarten where they come in the morning for meals and rest and are picked up in the evening.” (SA)

“We also offer home care services, which Beijing has been promoting. Elderly people don't need to stay at the center; they can request services from home. As a service center, we collaborate with our company, which has a home care team that provides these services at home…. any service you need is divided into 6-7 categories, such as home cleaning assistance, bathing assistance, haircuts, and meal assistance…. For example, if the elderly can't cook, we provide elderly meals delivered directly to their home. If you have a Beijing household registration, there are certain benefits, such as a meal costing around ten yuan with three dishes and a soup, and two staple foods like rice and steamed buns. The elderly will find it more comfortable than cooking themselves, as the food is less salty, less sugary, and not spicy. We deliver about 40 orders a day, including breakfast, lunch, and dinner.” (SA)

“We provide meal delivery. We have a small elderly cafeteria, and nearby residents can contact us by phone or other means, and our staff will deliver the meals…. We have about five orders by phone daily, not too many. Our staff deliver them by electric bike. Some elderly people come to our cafeteria for lunch every day.” (SC)

Currently, smart devices are commonly installed in community elderly care service centers in Beijing. As stated by respondents SA and SB, these smart devices are used to ensure the safety of elderly individuals within the service centers.

“We have many smart devices (at our elderly care service center). Each room in our center has a row of call response devices, such as by the bed, in the multifunctional hall, and in the bathroom. If the elderly need help, they can press a button, and our staff will respond promptly.” (SB)

“For example, our elderly care service center has cameras installed in every room and hall. Although the cameras are arranged by the company, they are connected to the

street-level government. If our network goes down for about 10 minutes, the Civil Affairs Bureau will send someone to check why." (SA)

Additionally, Type A elderly care service center also offers services for installing smart devices for their elderly residents and their families.

"We help install equipment, such as remote call systems similar to hospital call systems. Some agree to install a system to monitor the elderly's condition, allowing our staff to respond promptly if there are any issues. We also have a system similar to a smartwatch that monitors blood pressure and blood oxygen levels, which can be tracked and displayed on a screen. ... (These data) is reported to the elderly service center. "

The number of people served daily by the three interviewed elderly care service centers varies. The larger Type A elderly care service center can serve approximately 40 people per day. In contrast, staff members from the other two service centers indicated that they serve around 10 people each day. These service centers mostly be seen as temporary places for elderly individuals to engage in leisure and entertainment activities.

*"We primarily serve the elderly within a 3–4-kilometer radius, especially those in the nearby communities. I am mainly responsible for three communities: **,** and **. There are over 2,000 elderly residents in these three communities.... We have about 40 residents under our home care service, which used to go up to 70 during Covid-19." (SA)*

"I don't know the exact number, but every day more than a dozen elderly people come to our service center to sit, play cards, and so on. We almost know all of them." (SB)

"Around ten people daily. Although our place isn't big, we have air conditioning and heating. Some elderly people come here to play cards and chat, all of them live nearby. Now in spring, some people prefer to stay outdoors, but when the weather gets hotter, they will come here." (SC)

In terms of promoting the services of community elderly care centers to the target audience, apart from offline promotional methods (such as using posters, signage, and direct information introduction by staff), Center A has also been featured in media reports.

"We have put up a lot of posters in the residential areas of our community to promote our elderly care service center and the government service website. Our signage is quite noticeable, so residents can see it as they pass by. Additionally, our staff mention

and introduce this information during their regular inspections and visits to the elderly." (SB)

"Our service center has run for seven years. When the Beijing Municipal Government started to launch these service centers, it was already in the planning stage. If you search online, you can find reports about our elderly care service center on China Central Television and Beijing TV. We are quite well-known." (SA)

Additionally, all three interviewed elderly care service centers can currently be found on the "Beijing Elderly Care Service Website" which was launched in 2023. Displaying information about these care service centers on the website is mandated by the government.

"The government requires every street to have an elderly care service center, and each street has an annual target for building new centers. We were built in 2020. We've been working on "getting online" since last year, reporting our center's status to the street office, including what services we offer and how many beds we have." (SB)

"Our company probably handled the registration, but I know we are now listed on the elderly care service website." (SC)

I asked the respondents whether they were aware of the feedback from their service recipients—elderly individuals and their families—regarding the services provided by the elderly care centers. Although the responses were not entirely optimistic, it can be seen that the elderly and their families appreciate the services offered by the centers where the respondents work.

"Most elderly people and their families appreciate these services. After all, it's a helping hand. I think they are quite satisfied because some people have ordered more than once. As for those who haven't used it, we don't know what they think." (SB)

"I personally think that in this line of work, we don't aim for credit, but rather to avoid mistakes. Everyone knows that taking care of the elderly is risky. We just try our best to do our job. Within our supervision, if we see any problems with the elderly, we help out. If we can't solve the problem, we assist by calling emergency services. However, as long as people keep coming, it means we still have a role to play." (SC)

"I've received many elderly people here who insist on staying with me. They say, " Y (the respondent), I want to follow you. If you leave this elderly care service center, wherever you go next, I will go there too." Many elderly people say this now because they are afraid I might leave…. We have to admit that elderly people staying in service

centers often lack the company of their children and feel very insecure and lonely. If they encounter someone like me, who treats them with sincerity, they feel they receive care and love that even their children can't provide. They also feel a sense of security, thinking that as long as I'm here, they can rely on me, they feel at ease." (SA)

From the perspective of respondents, some believe that the current smart devices used in elderly care are already very advanced, which is a positive development.

"I think our smart elderly care services are quite good, and the equipment is quite advanced. For example, the call button alarm system in the center is much better than having nothing at all." (SB)

However, the respondents still perceive that the development of smart elderly care faces numerous practical obstacles. For instance, the elderly often have very limited digital skills and frequently require assistance to 'go online', which poses a new challenge for the caregivers.

"Smart elderly care without staff involvement won't be effective. No matter how smart it is, it's useless if you don't teach the elderly. The elderly at my place use the internet, and we have WiFi, but they still use their own data. If I don't reset it for each of them, they end up using their own money. They don't understand, and if you don't have the patience to serve them, it's useless. ...Elderly people, unless they have young people at home to watch over them, might not know how to charge the devices or upload data. So, I am not very optimistic about the equipment right now. I don't know how Beijing will address this in the future." (SA)

"If you're at home and want to use the community's elderly care services, you need to know how to use a smartphone. But many elderly people don't know how to use smart devices, and their children are worried about them being scammed." (SB)

Additionally, the elderly may lack access to information regarding the benefits they are entitled to, which hampers their ability to receive these benefits or services. This issue was also mentioned by Respondent E3 in the previous section. The government's efforts in disseminating relevant information are inadequate.

"The proportion of elderly people using smart elderly care is very low, and the government's promotion in this area is not sufficient…. The Jingtong Card, which allows elderly people over 60 to ride the bus for free, can actually work as a bank card. They have to activate the financial function to use it for payments. The information dissemination to these elderly people is not comprehensive. Out of ten elderly people living here, nine don't know that this card has a financial function. Many elderly people

who are completely disabled should apply for severe disability benefits of 600 yuan per month, but they don't even know about it. So, the government's promotion in this area is still lacking." (SA)

The elderly care centers where the respondents work also face challenges related to operational sustainability. The most significant issue is the shortage of staff, including both managers and caregivers. The lack of experienced and skilled caregivers remains a major problem for the elderly care centers. In the long term, the lack of staff not only limits the expansion of elderly care service centers but also may lead to operational difficulties, or even closure.

"Our center has only five people, including myself. If more elderly people came, it's uncertain whether we could handle it. This industry is dirty and tiring, and the salary isn't high." (SC)

"I think the hardest thing in Beijing in the future is that even if you have money and want to hire someone, there may not be suitable candidates. You can't guarantee their professional skills or service quality. For example, an elderly person—let's talk about the simplest thing—will they develop bedsores under your care? Turning them over, tube feeding, all these are professional issues. It's very difficult for an uneducated lady in her fifties or sixties to learn these things and then start working. Training needs to be very systematic and time-consuming." (SA)

"If you consider other service centers, I'll tell you it's still a matter of people. People include caregivers and also managers…Among our 13 center managers, only two are from the 80s generation…. One is me, and the other is Manager C. She studied medicine, so she can change urinary catheters without needing to send the elderly to the hospital. I am not a medical professional, but she is. Imagine placing your elderly in such a center where the manager is young, energetic, capable of managing, and has professional knowledge—you've really found a gem" (SA)

The interviewees also mentioned that the provision of current elderly care services is highly constrained by funding limitations. A common situation is that the three interviewed elderly care centers (heavily) rely on government subsidies. Apart from the larger and longer-operating Type A service center, which can achieve sustainable operations through self-financing, the other two smaller elderly care service centers struggle to cover their expenses. The elderly are unlikely to spend a large amount of money at elderly care service centers.

“If you ask how much money an elderly care center can make on its own, it can't make much. However, relying on government subsidies, it's no problem to maintain operations.” (SA)

“The main issue now is money. Installing and maintaining equipment costs a lot, and our staff can't fix it themselves. We have to call the manufacturer to send a technician. Besides, elderly care centers now rely on government subsidies. If we relied on our own income, we wouldn't last long, not even enough to pay salaries.” (SB)

“It's obvious that this elderly care center doesn't make money. How our company makes money, we don't know; as long as they can still pay my salary, that's enough. Every day we open the doors, it's a significant fixed cost. What money can the elderly contribute? It's good enough if they pay for meals at our cafeteria. If we charged for playing cards or reading newspapers, no one would come.” (SC)

Based on the results of the interviews, government-led smart elderly care services do not automatically connect the elderly and their families with service providers, even when there is a strong objective demand from potential recipients and the providers can offer the corresponding services.

Barriers between the supply and demand of smart elderly care services may exist in the channels through which the elderly and their families access these services (such as obtaining relevant information and lacking digital skills to use smart products), in the inadequate functionality of home nearby community elderly care service centers, or in the potential operational risks of these community service centers, which may have problems providing services consistently over the long term.

Ideally, the government should act as a bridge between the providers and recipients of social welfare; however, in practice, this role has not been adequately fulfilled. Additionally, for the existing problems or potential risks, the government has yet to develop effective solutions and response measures.

5 Discussion

In this chapter, I will discuss the findings derived from quantitative questionnaire surveys and qualitative interviews, integrating these results with the research questions posed in Chapter One.

From the perspective of elderly care recipients analyzing the barriers to digital inclusiveness in Beijing's current smart elderly care, according to van Dijk's (2002) digital divide theory and the quantitative analysis results in Section 4.1, the digital inclusivity of government-led smart elderly care services is influenced by several key factors, including the accessibility of smart elderly care, digital skill levels, perceived ease of use, perceived usefulness, and attitudes towards smart elderly care.

Based on the interview analysis in Section 4.2, from the perspective of elderly care providers, the barriers to digital inclusiveness in Beijing's current smart elderly care can be summarized by using the Technology-Organization-Environment (TOE) framework. Technologically, the current level of technology lacks elderly-friendly features. Organizationally, providers of elderly care services may face issues of operational sustainability, and the existing operational models may not be sufficiently inclusive for their service recipients. Environmentally, the current government support policies for smart elderly care are not yet sustainable and lack sufficient effectiveness.

5.1 Key Barriers of Influencing the Digital Inclusivity of Government-Led Smart Elderly Care: Recipients

5.1.1 Accessibility of Smart Elderly Care

The barriers to accessing smart elderly care for elderly and their families represent the initial gap in achieving digital inclusiveness. The accessibility of smart elderly care services and devices closely related to the manifestations of “smartness” of smart elderly care.

One manifestation of the "smart" aspect of elderly care services led by the Beijing government is the digitalization of service access methods, such as booking home care services through the Beijing Elderly Service Website.

Today, in China, particularly in metropolitan areas such as Beijing, the communication infrastructure in public spaces has become highly developed, with telephone signals and wireless networks being nearly universally available. However, the demand for smart

elderly care typically arises within household, and bridging this access gap requires that households can afford the costs of network access and telephone communication.

The Beijing Elderly Service Website, a government-approved information portal for qualified elderly care service institutions, is open for use by all users. However, to access services listed on smart elderly care information platforms (such as the Beijing Elderly Service Website), service recipients must use smartphones to make reservations or orders. From a "result-oriented" perspective (where successful access to elderly care services is the goal), citizens can also visit nursing homes or community elderly care service centers in person to book and order services.

The "smart" aspect of smart elderly care services is also reflected in the application of intelligent devices. Whether it is the safety-related smart monitoring devices frequently mentioned by respondents or smart health monitoring devices with data recording and transmission functions, users still primarily need to purchase these devices themselves. Not every individual can afford these devices. Although some community elderly care service centers, like the one where respondent SA is working, can install government-procured smart elderly care devices in residents' homes, skepticism about these devices is understandable due to the need for self-payment, limited choices of products (usually not well-known brands), and long-term usage requirements.

In summary, ensuring the accessibility of smart elderly care services involves addressing multiple layers of access barriers, including the construction of communication infrastructure, the development of digital information platforms for smart elderly care, and the provision of smart elderly care devices. The affordability of these products or services and the extent to which they gain users' trust are also important factors to consider.

5.1.2 Digital Skills

Although the moderating effect of digital skill levels on "perceived ease of use → perceived usefulness" was not significant and thus rejected in Section 4.2, it is undeniable that accessing smart elderly care services or operating smart elderly care devices requires a certain level of digital skills from elderly individuals and their families. Without these skills, they may face digital exclusion due to the lack of digital literacy.

In the context of family and filial piety in China, the digital skills required for smart elderly care are assessed not only at the individual level of the elderly but also at the family level. Reverse digital mentoring (where younger generations teach older family

members to use digital devices and acquire digital skills) has become a very common and significant means for older adults to gain digital skills. Unlike standardized courses and training programs, reverse digital mentoring typically addresses the specific issues encountered by the elderly. Therefore, the effectiveness of reverse digital mentoring depends on the teaching methods and approaches used by the younger generation, as well as their own digital skill levels.

Additionally, in Beijing, various NGOs and volunteer groups offer services aimed at enhancing the digital skills of the elderly, including workshops and lectures to help them learn basic electronic device usage. The Beijing municipal government welcomes such social welfare initiatives and supports them through government service procurement or special subsidies. These activities often collaborate with street or community-level government bodies to effectively reach their target groups and achieve their goals.

5.1.3 Opinions and Acceptance of smart elderly care

(1) Perceived Ease of Use

Perceived ease of use refers to the extent to which elderly and their family find a elderly care technology easy to use. This can be enhanced through intuitive design, clear instructions, and supportive resources such as user manuals and customer service. However, as respondent E2 noted that even though some devices and functions come with guidebooks, they often do not take into account the ways in which the elderly understand technology, lacking sufficient consideration for age-friendly design in the service.

(2) Perceived Usefulness

Perceived usefulness refers to the extent to which elderly individuals and the family believe that using smart eldercare services will enhance their quality of life or provide significant benefits. For example, respondent E1 mentioned time-saving, while E2 highlighted the convenience brought by these technologies. Understanding and meeting the specific needs and preferences of the elderly can significantly influence their perception of the usefulness of smart care technologies. How can the effectiveness of smart elderly care devices and services be demonstrated to their users is also an issue worth considering.

(3) Attitude towards Smart Elderly Care

Elderly individuals plus their family members' attitudes towards smart eldercare technology significantly influence their willingness to adopt and use these services. Interviews with respondents E1, E2, and E3 revealed that negative attitudes may stem from a fear of technology, concerns about privacy and security, or a general resistance to change. These concerns are very reasonable and widely prevalent. Conversely, positive attitudes can be fostered through positive experiences, perceived benefits, and supportive environments. Addressing these attitudinal barriers is crucial for promoting digital inclusivity.

5.2 Key Barriers of Influencing the Digital Inclusivity of Government-Led Smart Elderly Care: Providers

5.2.1 Technological Barrier: Insufficient Elderly-friendly Design

Although there is currently no widely accepted definition of elderly-friendly technology in smart elderly care in China, referencing Liu and Zhong's (2022) research, elderly-friendly technology should be "human-centered, respecting older adults' lives across online, offline, domestic, and social life." This concept should be applied to personal smart terminals, Internet services and mobile applications, community-based smart senior services, and the still-exploratory smart social welfare services (such as time banks).

Some elderly individuals, due to a solitary lifestyle combined with physical and psychological changes, easily feel lonely and anxious, reject unfamiliar environments, and are unwilling to accept and learn new things. This can lead to ambivalent feelings towards high-tech products like smart home devices (Yang et al., 2016). Ensuring that technology is suitable for elderly users is crucial to prevent them from being "abandoned" by technological advancements once they gain access to them. This includes considerations of ease of use, accessibility features, and overall user experience.

Technologies that do not consider the needs of the elderly can be difficult to use, leading to underutilization of the available features. For instance, respondent E3 reported that elderly individuals struggle with fingerprint unlock features on smartphones, and the small buttons often result in accidental presses due to less dexterous fingers. Designing technology with the elderly in mind involves simplifying interfaces, enlarging text and buttons, and providing clear and intuitive instructions. By addressing these factors, smart eldercare devices can become more inclusive and effective, ultimately enhancing the quality of life for older adults.

5.2.2 Organizational Barrier: Comprehensive Challenges Related to Finance, Human Resources, and Service Delivery

In section 4.2, respondents from elderly care service providers repeatedly expressed concerns about the current manpower and financial resources of community elderly care service centers. This indicates that the current operational situation of these centers is neither healthy nor sustainable. It is evident that if Beijing does not focus on cultivating human resources in the elderly care sector and increasing funding for community elderly care service centers, the smart elderly care services in Beijing will struggle to meet the increasing demand from a growing elderly population. The insufficient provision of elderly care services cannot be regarded as inclusive social welfare.

The shortage of manpower is particularly alarming, as it directly affects the quality of care provided. With insufficient staff, elderly care centers may not be able to offer personalized and attentive care to each resident, potentially leading to neglect and decreased overall well-being among the elderly. Overworked and understaffed caregivers may also experience burnout, further exacerbating the problem and leading to high turnover rates. This cyclical issue can undermine the stability and consistency of care, which is crucial for the elderly population, who often require ongoing and reliable support.

Financial constraints add another layer of difficulty, limiting the ability of elderly care centers to maintain and upgrade their facilities, invest in new technologies, or provide competitive salaries to attract and retain skilled caregivers. Without adequate funding, it becomes challenging to implement innovative solutions that could improve efficiency and the quality of care, such as smart technologies for monitoring health and enhancing daily living activities. The lack of financial resources also means that elderly care centers might struggle to offer additional services that address the social, emotional, and mental health needs of the elderly, which are essential components of holistic care.

Moreover, the growing elderly population in Beijing places increasing pressure on these already strained resources. As the demographic shift continues, the demand for elderly care services will rise, potentially overwhelming the existing infrastructure. Without significant investment in both human and financial resources, community elderly care centers will be ill-equipped to handle this surge, leading to longer waiting times for services, reduced access to care, and potentially lower standards of service provision.

In terms of service delivery, in 2024, the Beijing Civil Affairs Bureau introduced the "Management Measures for Star-Rating of Elderly Care Institutions in Beijing" to incentivize elderly care institutions to provide higher quality services. According to

interviews in section 4.2, respondents from elderly care service providers frequently mentioned that the elderly individuals who often visit community elderly care centers are generally in relatively good health. In the interview with Respondent SC, he specifically noted, “taking care of the elderly is risky” and “in this line of work, we don't aim for credit, but rather to avoid mistakes.”

Considering these factors, this situation may introduce significant drawbacks to the provision of smart elderly care as a social welfare service. Government-led elderly care providers might prefer to select "high-quality" service recipients to achieve better performance outcomes and secure more government subsidies (Ding & Yang, 2015; Guul et al., 2021). Although I did not find concrete evidence of this phenomenon during the interviews, there is a theoretical possibility that it could occur. Such a scenario would severely undermine the inclusiveness of elderly care services.

This potential for selective service provision, known as "cream-skimming," can lead to the exclusion of those who are most in need of care, such as individuals with more severe health conditions or limited financial resources. By prioritizing healthier, less resource-intensive elderly individuals, care institutions may inadvertently widen the gap in access to essential services. This practice would not only contradict the principles of equitable and inclusive social welfare but also exacerbate existing social inequalities among the elderly population.

Furthermore, the star-rating system, while intended to improve service quality, may inadvertently create perverse incentives. Elderly care institutions might focus excessively on meeting the criteria that influence their ratings, rather than addressing the comprehensive and individualized needs of their residents. This could result in a narrow approach to care that prioritizes easily quantifiable outcomes over holistic well-being, ultimately compromising the quality of life for those who require more complex and personalized care.

5.2.3 Environmental Barriers: Insufficient Effectiveness of Policy Instruments Support

Elderly care, as a typical form of social welfare, requires inclusiveness to ensure that all elderly individuals, regardless of their socioeconomic status, can access the necessary benefits and services. This further calls for the establishment of an elderly-friendly society that cares for and supports older adults.

Inclusive policy instruments for universal access to (smart) elderly care forms the foundation of elderly care inclusiveness. It involves providing adequate financial

support to elderly individuals so they can maintain a basic quality of life. This includes economic assistance from the government through pensions, social insurance, and subsidies to help those with insufficient or no income sources. Additionally, consideration must be given to medical expenses and long-term care costs (including the purchase of care equipment and supplies and seeking care services), which often constitute a significant financial burden for elderly households. Although Beijing currently provides economic subsidies for some elderly individuals to use (smart) elderly care services, not all elderly individuals benefit from this policy, particularly those with relatively poor economic conditions who have not yet reached the subsidy threshold. This situation somewhat hinders the further dissemination of (smart) elderly care in society.

Despite the efforts by Beijing authorities to enhance smart elderly care, as illustrated in section 1.1, it is evident that, according to the policy model created by Rothwell and Zegveld (1984), Beijing predominantly employs environmental policy tools. These tools reflect the influence of policies on the smart elderly care industry, mainly through government policy planning, financial support, tax incentives, regulatory controls, standard setting, and strategic measures to guide the adjustment and transformation of the smart elderly care industry structure, thereby creating a favorable development environment (Huang & Zhang, 2020).

In contrast, there are relatively few supply-side policy tools that can drive the smart elderly care sector, such as government funding, technological investment, facility investment, information provision, talent cultivation, and the creation of demonstration projects (Huang & Zhang, 2020). Moreover, demand-side policy tools aimed at reducing market barriers and negative externalities, such as government procurement and service outsourcing, are currently almost nonexistent (Huang & Zhang, 2020).

The predominance of environmental policy tools, particularly indirect ones, results in a lack of specific and operational guidelines for the development of smart elderly care in Beijing. Insufficient policies regarding talent cultivation and funding investment fail to attract social forces, which can lead to talent shortages and consequently limit the development of smart elderly care.

This reliance on environmental policy tools, while creating a supportive backdrop, does not directly address the critical needs of the smart elderly care sector. Government policy planning and strategic measures, though beneficial, are not enough to spur innovation and growth without the accompanying supply-side and demand-side tools.

Furthermore, the current regulation of smart elderly care in Beijing may be insufficient, as respondent E2 mentioned. The current regulation of elderly care providers primarily focuses on the "access" stage and periodic inspections, for instance, the civil affairs department reviews the operating qualifications and conditions of elderly care service providers and conducts annual inspections of the operation and service quality of elderly care institutions. However, there is still a lack of relevant criteria for evaluating specific services or individual cases. Even though a new star-rating system for elderly care service providers has been implemented in 2024, this system still focuses on assessing the overall quality of service provider and does not reflect the quality of specific services.

The lack of regulatory rigor can result in some individuals being excluded from elderly care services, as noted in the previous section on the phenomenon of user sorting or cream-skimming. Inadequate regulation can lead to significant disparities in the quality of care provided by different institutions. Without stringent oversight, some providers may cut corners to reduce costs, resulting in substandard care for the elderly, who may suffer physical, mental, or financial harm. Lagging regulation not only negatively impacts the elderly and their families but also damages the reputation of the smart elderly care industry and the government’s public services, thereby undermining the inclusiveness of elderly care services.

In the development of smart elderly care, the government and providers of smart elderly care devices or services must pay particular attention to privacy protection. Ensuring the privacy of the elderly is crucial to fostering trust in smart elderly care in the society. The operation of smart elderly care relies on the generation, transmission, and storage of data related to user privacy. However, the current situation in Beijing indicates that a clear and explicit environment for data privacy protection in smart elderly care has yet to be established.

In recent years, public awareness of personal and family data privacy protection has been increasingly heightened. However, the author's investigation into the current smart elderly care services in Beijing reveals that service providers often give very vague statements regarding the storage, management, and ownership of such information, and fail to provide sufficient reasons to assure that data and privacy are well protected.

5.3 Possible Ways to Enhance (Digital) Inclusivity of Government-Led Smart Elderly Care

To enhance the digital inclusivity of smart elderly care, Beijing authorities must implement several comprehensive strategies.

It is essential to ensure that elderly individuals and their families have sufficient channels to access resources, such as economic subsidies, to facilitate the universal benefits of smart elderly care services. Additionally, regarding the digital skills required for utilizing smart elderly care and related technologies, Beijing should innovate ways to help citizens to develop digital competencies, leveraging the role of families in digital skill enhancement. Moreover, efforts should be intensified to promote and popularize smart elderly care technologies and platforms in ways that are easy for the elderly to understand, ensuring that more families in need are informed about and can benefit from these services.

The diversity and effectiveness of supply-side policy tools need to be increased. This includes establishing dedicated government funds to support the research, development, and infrastructure of smart elderly care, as well as investing in advanced technologies such as artificial intelligence, the Internet of Things, and robotics to improve service delivery and operational efficiency. Additionally, implementing training programs in collaboration with educational institutions will help develop a skilled workforce, while launching pilot projects can showcase successful models and encourage broader adoption.

On the demand side, enhancing policy tools involves increasing government procurement of smart elderly care services and further encouraging public-private partnerships to outsource specific services, leveraging the efficiency and innovation of the private sector. Providing subsidies or vouchers for elderly care services will make these services more affordable and accessible, thereby further driving demand. Developing clear, actionable guidelines for the implementation of smart elderly care technologies and establishing industry standards will ensure the quality and consistency of service delivery.

Addressing the risk of unsustainable smart elderly care services requires a focus on human resource development. Offering specialized training programs for elderly care professionals and developing clear career pathways with incentives will attract and retain talent in the sector. Promoting volunteer programs and community engagement can supplement professional care services, while increasing government funding and encouraging sustainable financial planning will ensure that community elderly care centers have the necessary resources to operate effectively. Attracting private investors and philanthropists through more flexible public-private partnerships will provide additional financial support.

Mitigating the risk of user sorting or cream-skimming in elderly care services requires the implementation of inclusive policies that mandate equal access to services for all

elderly individuals, regardless of their health status. Robust monitoring and evaluation mechanisms must be established to prevent selective service provision, and performance metrics should value inclusivity and comprehensive care quality. Public awareness campaigns and the support of advocacy groups will educate elderly individuals and their families about their rights, holding providers accountable for delivering inclusive services. Additionally, training programs for elderly care providers and community involvement in planning and oversight will ensure that services meet diverse needs.

Strengthening regulation and oversight of smart elderly care is critical to ensuring inclusivity. Developing comprehensive regulations that cover all aspects of smart elderly care, including technology use and service standards, and conducting frequent inspections will ensure compliance. Providing incentives for institutions that meet regulatory requirements and establishing clear mechanisms for reporting issues will protect consumers. Engaging stakeholders in the regulatory development process and creating feedback loops for continuous improvement will ensure that regulations keep pace with technological advancements and emerging challenges. Transparency and accountability measures, such as public reporting of compliance status and performance metrics, will further enhance the digital inclusivity of smart elderly care.

5.4 Further Discussion

The transformation of the elderly care industry through smart elderly care will continue. Like other cities and national governments, Beijing is still exploring ways to make smart elderly care more high-quality and efficient, while covering an increasingly larger elderly population to achieve inclusiveness.

However, at times people may question whether the manifestation of "smart" of smart elderly care, particularly the digitalization and smartification of access methods, is necessary. For example, according to a response from the Beijing Civil Affairs Bureau to my information disclosure request (see Appendix D for details), "since its launch, the Beijing Elderly Care Service Website and its mini-program have facilitated 51,100 service connections, mainly including the cumulative signing of 43,000 contracts online to prevent the risk of collecting large advance payments and to protect the rights of the elderly." Nearly 85% of these service connections involved "online contract signing." It can be inferred from this description of "preventing the risk of collecting large advance payments" that the Beijing government likely recommends or mandates that elderly care institutions and the elderly and their families use the Beijing Elderly Care Service Website when signing contracts for admission to elderly care institutions.

In practice, this might mean that the elderly and their families, having already visited the elderly care institution (or with the elderly already residing there and preparing to sign up for the next year), would open the "Beijing Elderly Care Service Website" on both the service provider and user sides to complete the contract signing online. This contract signing, if not mediated by the government website, could still be carried out through traditional transaction methods. The government may tend to showcase such cases to embellish its achievements, but that is another matter.

In this instance, the "smart" website's role extends beyond the moment of contract signing (which, in reality, might have added some inconvenience). More importantly, it serves as a supervisory and protective mechanism where the government, as a more credible entity, ensures oversight and protection in the citizens' access to welfare services.

The degree of "smartness" (level of intelligence) in smart elderly care also depends on the pace of technological advancements. In this regard, "smartness" might be more easily perceived as useful by the public and more favored by the elderly and their families. The concept of elderly care robots has been popular for decades; however, humanoid elderly care robots that can meet urgent service needs still remain prohibitively expensive and out of reach for the average elderly person's daily life. Nevertheless, future technological advancements hold promise. For instance, the advent of ChatGPT has helped some individuals alleviate loneliness through conversations, surpassing the effectiveness of any previous chatbot (Pani et al., 2024).

With the rapid development of artificial intelligence and machine learning technologies in recent years, future smart elderly care devices are expected to become more widespread and intelligent. This progress is anticipated to make these technologies more accessible and beneficial, thereby enhancing the quality and inclusiveness of elderly care services.

The development of smart elderly care may also bring about unexpected changes in social structures. For instance, "solo living" might become more prevalent. More and more young people today recognize that "elderly care" is a composite concept that can be broken down into different functional modules. These modules, such as dining, medical care, and cleaning, can be managed through the effective allocation of hourly workers, caregivers, and social services.

Additionally, contemporary young people generally possess the necessary digital skills and, as "digital natives," have a preference for online services. When they turn older, with the gradual popularization of smart elderly care, these services are likely to play an

increasingly significant role in the lives of future elderly individuals. Advanced technologies such as AI-driven health monitoring systems, automated home assistance devices, and virtual companionship platforms are poised to enhance the quality of life for the elderly, allowing them to maintain their independence longer.

It is therefore likely that the number of people who marry or give birth to children only reluctantly due to future elderly care considerations will continue to decline in the future. This shift could lead to profound changes in family dynamics and societal expectations. Traditional family structures might evolve, with less emphasis on the necessity of marriage and offspring for elderly support. Communities could become more diverse, with various living arrangements and support systems tailored to individual preferences rather than societal pressures.

The societal view on single individuals might shift significantly, with the stigmatization of "singlism" being reversed. As single lifestyles become more normalized and accepted, society will become more inclusive by embracing and accommodating groups with diverse value orientations. This inclusivity will reflect in various aspects of life, reducing discrimination and fostering a more supportive environment for everyone, regardless of their marital status. The shift in perspective could lead to a more compassionate and understanding society.

6 Conclusion

6.1 Research Result

This thesis has shown that it can be understood that Beijing provides government-led smart elderly care as a basic social welfare service. This primarily manifests in the form of providing elderly residents with community-based home care services in a "smart" way, offering smart elderly care devices, and establishing the "Beijing Elderly Care Service Website," an information platform that consolidates elderly care service resources across the city. However, the current digital inclusiveness of smart elderly care is still very limited.

Firstly, users may face intentional or unintentional exclusion from welfare provision (such as being unable to access promotional information or find the costs unaffordable) or "cream skimming" (where those with less severe needs are favored). Secondly, users may be excluded by the digital means of access, such as being unable to book services through the Beijing Elderly Care Service Website. Additionally, accessing smart elderly care services and using smart elderly care devices require certain digital skills, and elderly individuals and families lacking these skills may still be unable to use the smart devices or fully utilize their functions even if they have already owned them. The elderly-friendliness of smart elderly care also needs to be improved.

The awareness and perception of smart elderly care by the elderly and their families also affect their inclusion in smart elderly care. Groups that are skeptical or negative about smart technology, or that perceive the usefulness and ease of use of smart elderly care technology and services as insufficient, will find it more difficult to obtain smart elderly care services and enjoy the convenience.

Moreover, the direct providers of smart elderly care services, Beijing's community elderly care service centers, may currently face potential operational risks, including the risk of closure. Additionally, Beijing's current elderly care human resources are insufficient to cope with a future larger elderly population. Although these issues are not within the scope of digital inclusiveness, they pose a significant threat to social inclusiveness.

To enhance the digital inclusivity of smart elderly care, it is essential for Beijing government to provide economic subsidies through multiple channels to support elderly individuals and their families. Innovative methods should be developed to enhance citizens' digital skills, fully utilize the role of families in this process, and intensify the

promotion of smart elderly care technologies. These approaches will ensure that more individuals in need can become aware of and benefit from these services.

Beijing authorities also must implement comprehensive strategies that encompass both supply and demand-side policy tools. This includes establishing government funds, investing in advanced technologies, and developing training programs with educational institutions to create a skilled workforce. Launching pilot projects will showcase successful models and encourage broader adoption. On the demand side, increasing government procurement, further encouraging public-private partnerships, and providing subsidies or vouchers will make services more accessible and drive demand. Clear guidelines and industry standards are essential for consistent service delivery.

Addressing the sustainability of smart elderly care requires focusing on human resource development through specialized training, clear career pathways, volunteer programs, and increased funding. Attracting private investors and philanthropists through flexible partnerships will provide additional support.

Mitigating the risk of selective service provision involves implementing inclusive policies for equal access, establishing robust monitoring mechanisms, and valuing inclusive performance metrics. Public awareness campaigns and advocacy groups can educate the elderly about their rights, while training programs and community involvement ensure diverse needs are met.

Strengthening regulation and oversight includes developing comprehensive regulations, conducting frequent inspections, and providing incentives for compliance. Clear reporting mechanisms, stakeholder engagement, and continuous feedback loops will ensure regulations remain current. Transparency and accountability measures, such as public reporting, will further enhance digital inclusivity in smart elderly care.

6.2 Limitations

6.2.1 Limitations of Case Study

This study uses Beijing as a case to investigate the digital inclusivity of government-led smart elderly care services. Furthermore, due to the unique political and economic conditions of Beijing, the capital of China, the external validity of this study might be limited. The results may not be applicable to studies on the digital inclusivity of smart elderly care services in other cities or countries.

Additionally, due to the limited timeframe for this research, only 355 questionnaires were successfully collected, and six semi-structured interviews were conducted. A

larger sample of questionnaires could make the quantitative data analysis more representative, while more interview samples could potentially reveal a greater diversity of viewpoints.

6.2.2 Limitations of Online Surveys

The questionnaire survey data in this study were primarily collected and disseminated through online tools, and the semi-structured interviews were also conducted via video conferencing software. This approach may overlook the nuances of non-verbal communication.

Moreover, there is a potential for sampling bias, especially related to the part of online questionnaire surveys. The method of online surveys fully respects the voluntary participation of users. Users who are willing to click on the survey link and view the questionnaire may possess higher digital literacy in using smart devices. In terms of personality traits, they may be more curious about new things, a characteristic that could correlate with a more open and positive attitude towards new technologies. These factors can result in a sample that is not fully representative of the broader population, potentially affecting the study's findings. Additionally, these two factors related to the questionnaire content may lead to certain biases in the measurement results.

6.2.3 Absence of Interviews with Government Officials

It is very unfortunate that this study did not include any interview with government officials within the Beijing municipal government regarding smart elderly care. I only received responses to written information requests.

Due to lack of direct connection with policymakers, the understanding of policymaking in this research is derived solely from publicly available policies, lacking the firsthand perspectives and evaluations of current government-led smart elderly care from policymakers.

Furthermore, the study cannot explore whether there are power struggles between relevant government departments during the policy-making process for smart elderly care. Information about which departments' administrative goals are prioritized, how conflicts of interest between departments are resolved, and how they negotiate to maximize common benefits is missing.

Finally, the study does not address how the government monitors the service quality and potential risks of the current smart elderly care service providers post-approval. These issues warrant further investigation.

6.3 Future Research

For future research on topics related to smart elderly care or digital inclusivity, quantitative research can adopt or adapt established research models (such as the Unified Theory of Acceptance and Use of Technology (UTAUT) model and its derivative models) or propose new research models to explore the relationships between study variables.

There is the possibility of conducting future research that could further segment the elderly population under study, such as those living alone and those who are no longer capable of taking care of themselves, to provide more targeted and differentiated analyses. This will help to more accurately identify the existing issues within these topics and propose more specific countermeasures.

Additionally, future related research can employ comparative study methods, such as comparisons between different regions. Comparative studies can effectively identify the characteristics of different research subjects, which can help in drawing lessons from their strengths.

Furthermore, this study is cross-sectional research, representing the situation as of 2024. Future related research could employ more diverse data (e.g. China Longitudinal Aging Social Survey and China Health and Retirement Longitudinal Study) for longitudinal studies to observe changes in the field of smart elderly care and gain more insights.

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