PERCEPTION AND COMPREHENSION OF SIGNAGE WAYFINDING SYSTEM IN HOSPITALS FOR THE ELDERLY IN GUANGZHOU, CHINA

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PERCEPTION AND COMPREHENSION OF SIGNAGE WAYFINDING SYSTEM IN HOSPITALS FOR THE ELDERLY IN GUANGZHOU, CHINA

by

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"In a short time, if we wish, we can use the light to shine on the darkness around us on our journey. Just as in the ancient torch-race, which seemed to Lucretius to be the symbol of all life, we run forward along the road with a torch in our hand, and soon someone comes from behind and catches up with us. All our skill is in passing the torch of light fixed in his hand, and we fade into the darkness".

All our academic work so far has been to be that torch-runner, to pass the torch of this light fixation into the hands of those who run from behind and catch up with us while we fade into the darkness.

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ABSTRAK

Dalam konteks penduduk yang semakin tua dan berusia di China, mencari arah laluan dalam persekitaran hospital yang besar dan rumit merupakan salah satu cabaran utama yang dihadapi oleh warga emas. Pada masa ini wujud kekurangan penyelidikan mengenai persepsi dan kefahaman warga emas terhadap papan tanda di hospital-hospital negara China. Tujuan kajian ini adalah untuk menentukan tahap keperluan untuk papan tanda and arah laluan dalam hospital, di kalangan warga emas dan untuk memberikan cadangan untuk sistem papan tanda mesra umur. Kajian ini menggunakan pendekatan kaedah campuran untuk menyiasat persepsi dan kefahaman warga emas terhadap sistem papan tanda sedia ada dalam tiga hospital di Guangzhou. Hasil kajian ini menunjukkan bahawa kebanyakan warga emas menghadapi pengalaman sesat di hospital, dan kebanyakan daripada mereka memilih untuk bertanya arah daripada orang lain, dan kemudiannya diikuti dengan mengikuti sistem papan tanda. Warga tua lebih kesukaran membaca dan mentafsir papan tanda hospital. Perkara yang paling mereka hargai ialah grafik, teks, warna dan kemas kini sistem papan tanda kerana elemen-elemen sebegini secara langsung mempengaruhi kebolehbacaan dan kefahaman sistem panduan. Adalah didapati bahawa peserta yang lebih muda dan lebih berpendidikan bertindak balas dengan lebih pantas dan lebih tepat. Selain itu, lima ciri kognitif simbol dikaitkan secara positif dengan tahap pemahaman; ketepatan gambaran semantik adalah peramal terbaik, diikuti dengan kebiasaan dan kekonkretan, kerana ciri-ciri ini lebih berkemungkinan mempengaruhi

pemahaman simbol dan keupayaan meneka. Kesimpulan kajian ini adalah mendedahkan kepentingan mengambil kira suara pengguna warga emas semasa membentuk sistem papan tanda hospital. Fokus penting adalah untuk menumpukan perhatian kepada persepsi dan keperluan sebenar warga tua, meningkatkan kefahaman papan tanda, dan akhirnya, meningkatkan kecekapan mencari laluan serta pengalaman perkhidmatan perubatan.

PERCEPTION AND COMPREHENSION OF SIGNAGE WAYFINDING SYSTEM IN HOSPITALS FOR THE ELDERLY IN GUANGZHOU, CHINA

ABSTRACT

In the context of China's aging population, wayfinding in large and complex hospitals is one of the key challenges faced by the elderly.Currently, there exists a lack of research on the elderly's perception and comprehension of hospital signage in China. This study aims to determine the actual requirements of hospital wayfinding signage among the elderly, and to provide recommendations for an age-friendly signage system. This study used mixed methods to investigate the elderly's perception and comprehension of signage systems in three hospitals in Guangzhou. The results of this study shows that most elderly have chosen to first ask others for directions, before using and following signage systems. And the elderly experience more difficulty reading and interpreting hospital signage. In signage, importantly helpful and valuable to the elderly are graphics, text, colour and updates to the signage system, because these elements directly affect the readability and understandability of the signage. Additionally, younger and more educated participants responded faster and more accurately. Moreover, the five cognitive features of symbols are positively correlated with comprehension levels; the accuracy of semantic depiction showed as the best predictor, followed by familiarity and concreteness, as these features are more likely to affect symbol comprehension and guessing ability. In conclusion, this study reveals the importance of considering the opinions and feedback of elderly users in designing hospital signage systems. It is important to pay attention to the actual perceptions and needs of the elderly people, enhance the understandability of signage, which ultimately can improve wayfinding efficiency and the medical service experience.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Social aging is occurring globally, the percentage of the population over 65 years of age currently ranges from 6% to 16% in regions such as Asia, North American states, and Europe, and it is estimated to reach between 17% and 29% by 2030 (Sara J. Czaja et al., 2019), as shown in Figure 1.1.Some scholars predict that China will gradually overtake Japan in the next 30 years as the country with the highest aging population in the world (Beard et al., 2016). The elderly population is expected to increase dramatically in the next few decades, the over-65 cohort will more than double to 400 million people by 2049 (Figure 1.2).

According to the 9th National Population Census released by China's National Bureau of Statistics, with 217 million people over the age of 65, accounting for15.4% of the total population (National Bureau of Statistics of China, 2023), with the number of elderly people tripling in 40 years. This rate is much higher than the world's criteria for defining an aging society, set at 7% by the United Nations (United Nations Department of Economic and Social Affairs, 1958). Similarly, the aging population trend is also a concern in China's large cities like Guangzhou. By the end of 2023, the population of Guangzhou aged 65 and above accounted for 13.75% of the registered population (National Bureau of Statistics of China, 2023). However, in the central city of Guangzhou, the proportion of people aged 60 or above is high. For example, in Yuexiu district (333,600), Haizhu district (306,800), and Liwan district (241,300), the elderly population accounts for more than 20% of the registered population in these districts (Guangzhou Municipal Bureau of Statistics, 2023), as shown in Figure 1.3.

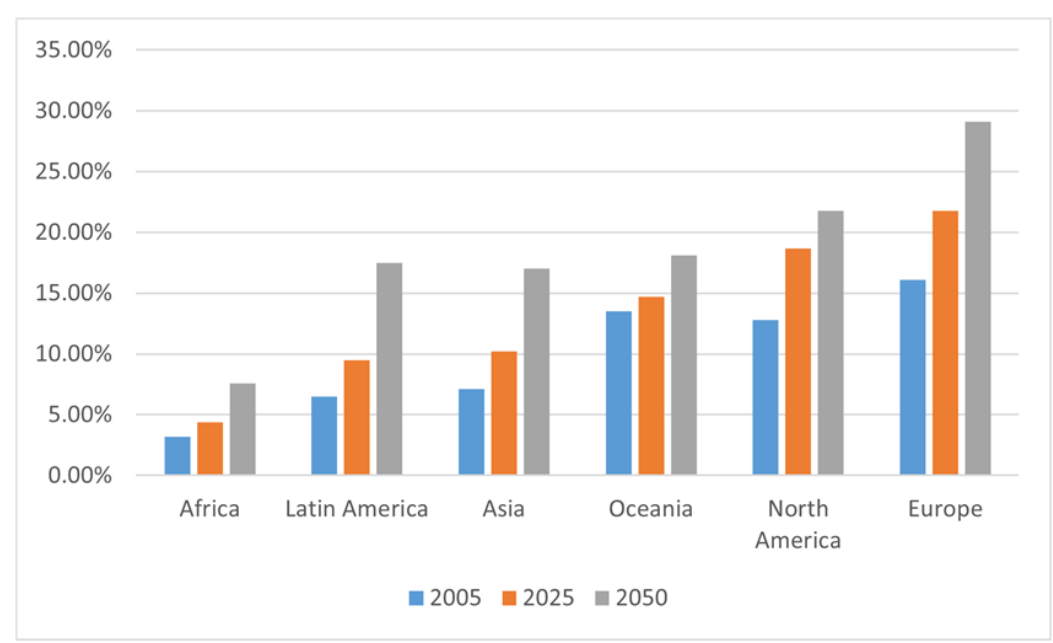
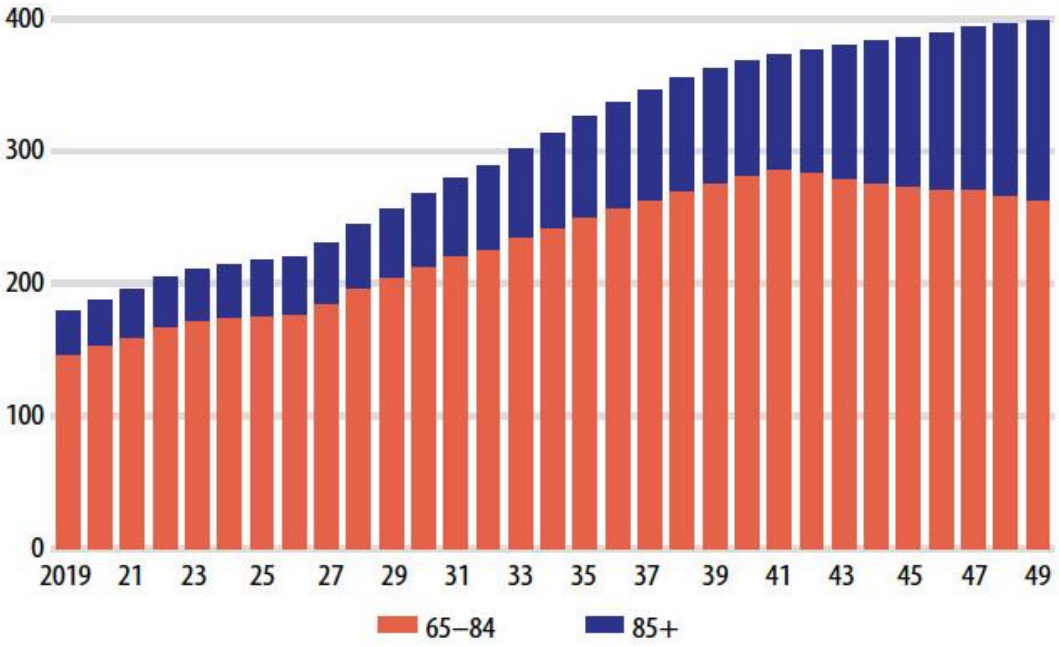


Figure 1.1 World-wide trends in the population aged over 65



Source: *China Population Prospects 2018*, China Population and Development Research Center, Beijing

Figure 1.2 Projections of the population aged 65-84 and 85+ in China

Area	Age	Resident population	%	Migrant population	%
GUANGZHOU	>60	1,952,100	18.86	483,100	100
	>65	1,423,100	13.75		
LIWAN	>60	241,300	30.32	93,600	19.37
YUEXIU	>60	333,600	28.41	83,100	17.21
HAIZHU	>60	306,800	27.08	71,900	14.88

Figure 1.3 Elderly population in Guangzhou and three study districts

As the elderly population grows, the number of older people visiting hospital outpatient clinics increases(Barnes et al., 2016; Ford et al., 2020). Therefore, improving the quality of life and well-being of older people through hospital wayfinding design design support is an issue facing China today. Especially, super cities like Guangzhou have good medical resources and conditions that attract people from all over the country to seek medical treatment. The total number of consultations in Guangzhou's hospitals was 126 million in 2020 (Guangzhou Municipal Health Commission, 2021). As a result, these hospitals' colossal traffic and high utilization rate challenge the service and management of Guangzhou's hospitals, especially hospital signage systems. As an integral part of the hospital-built environment, the planning and design of signage systems is particularly important for the wayfinding needs of a wide range of users. Better facility design and signage systems can improve patient perceptions of services, reduce hospital anxiety, and improve patient care and health results (Dolah et al., 2023; En-I & Bebit, 2021; En-I et al., 2023; Rodrigues et al., 2019).Therefore, enhancing users' visual perception, recognizability, and comprehensibility is crucial when using signage in healthcare environments, especially for older adults (D. Gibson, 2009; J. M. Wiener & Pazzaglia, 2021).

Figure 1.4 A sample of wayfinding sigange system in Chinese hospital

Existing literature identifies factors that affect signage recognition and comprehensibility as including primarily individual user factors and the physical and cognitive features of the signage (Iftikhar et al., 2020; Jamshidi et al., 2020; Jamshidi & Pati, 2021).Based on individual differences in age, educational level and gender can influence individual wayfinding behavior, including spatial ability and cognitive ability (Afyouni et al., 2012; W. Dong et al., 2020; Gärling et al., 1986a; Kirasic et al., 1992; Romedi Passini et al., 1990; Postma et al., 2004; Ramanoël et al., 2020).Based on previous research, emphasis has been placed on improving the recognizability and comprehension of signage by improving the physical characteristics of the signage (e.g., color, text, graphic symbols, layout design, mounting location, etc.) (Gao, 2020; Rodrigues et al., 2019, 2020). However, the physical features of the signage can largely help users to recognize wayfinding information, the cognitive features need to be taken into account as far as the accuracy of understanding is concerned.Cognitive features include familiarity, concreteness, simplicity, meaningfulness, and accuracy of semantic description (Y. Liu & Ho, 2012; McDougall et al., 1999; Mustapha et al., 2024; A. W. Ng & Chan, 2007; Prasetyo et al., 2021).

In China, signage system design is in its infancy, many hospitals lack a good signage system, and users mostly need verbal instructions from hospital staff to find their way around and often get lost, a situation that is more prominent in the elderly (Deng et al., 2024; B. Hu, 2023). Based on previous literature (see subsection 1.2), this study summarizes the design issues of existing hospital signage systems in China and further understands the status of existing signage systems in Guangzhou hospitals based on preliminary research (see subsection 2.4.8). Figure 1.4 shows a sample of wayfinding sigange system in Chinese hospital. The most critical problem is that signage systems are inadequate and lack planning and standardization, and signage design is difficult for older people to understand, which somewhat reduces its frequency of use (Gao, 2020; Gong, 2012; S. Lee et al., 2014; Qi & Chen, 2020; J. Wu et al., 2022; Y. Zhang, 2019).Due to the specialized nature of hospital departments, text message signage cannot accurately convey information, whereas it is a challenge to convey wayfinding information with easy-to-understand graphic symbols (J. J. Foster & Afzalnia, 2005; Hashim et al., 2014; Jones, 1978; S. Lee et al., 2014).Although the Standardization Administration of the Republic of China established a Recommended Standard for healthcare symbols used in healthcare facilities (GB/T 10001.6-2006) (Standardization Administration of the Republic of China, 2006), this is non-compulsory to be implemented in China’s tertiary hospitals. As a result, the current healthcare symbol system used in hospitals is confusing.

In addition, wayfinding in hospitals is one of the challenges the elderly face due to their physical and cognitive abilities decline. As a wayfinding aid, an effective hospital signage system can assist elderly people’s wayfinding, reducing their stress and chances of getting lost on the premise. However, Chinese hospitals' current signage and wayfinding information design cannot meet their wayfinding needs (Qi &

Chen, 2020; N. y. Wu, 2019; W. F. Zhang, 2019). Studies have shown that elderly people are often less efficient at wayfinding and require more time to reach their destination, and they are more likely to get lost, as getting lost can bring some negative emotions (J. R. Carpman et al., 1985; M. S. Chen et al., 2021; Tzeng & Huang, 2009; Vigolo et al., 2020). When hospital signage is not designed to meet the requirments of the elderly, it is often difficult for them to recognize or familiarize themselves with the building, making it difficult for their wayfinding.Moreover, disorientation also takes a toll on the hospital, and a study reveals that hospitals lost almost 4,500 hours and USD 202,000 per year due to disoriented people asking for directions (Mora et al., 2014; Rodrigues et al., 2020). It is essential to emphasize that the signage system is not only a communication tool but is also considered a service item to facilitate communication between the elderly and the environment and should also be considered a management tool to regulate environmental information effectively (Gresham et al., 2019; O'Neill, 1991; Rousek & Hallbeck, 2011). Therefore, the spatial anxiety of users can be reduced from the perspective of the hospital signage system, especially for the elderly group, which is conducive to improving the quality of the hospital environment and medical experience.However, there is little research focusing on the perception and comprehension of existing signage systems among the elderly groups. Designers are under pressure to develop a sustainable signage system that meet the elderly people’s needs.

Under this background, healthcare facilities must upgrade the wayfinding experience of the elderly by improving the design of the signage system. The level of user perception and understanding of the existing signage system needs to be assessed prior to the design and improvement of the signage system. Given the important influence of the above arguments, this study investigates two vital areas regarding the

effectiveness of signage for wayfinding in hospitals for elderly people. Firstly, this study will conduct detailed and targeted research, including field research to identify the current status of the signage systems in the three hospitals as well as problems, and investigate specific feedback on signage design preferences from elderly visitors to the hospitals, whose opinions will be solicited to see if existing healthcare signage is adequately comprehended. In addition, symbol comprehensibility testing will conduct with elderly users to ensure that which healthcare symbols were difficult for users to understand. Based on these efforts, this study intend to provide more specific design recommendations for signage design for hospital facilities.

In sum, this study focuses on improving the signage design of hospitals in China from the perspective of wayfinding for the elderly by evaluating the comprehensibility of the existing hospital signage systems on wayfinding, which can enrich the direction and means of healthcare signage design research and provide theoretical and practical experience for the design of wayfinding systems in healthcare facilities in other regions. In addition, it is of great significance to the organization and management of Chinese hospitals to enhance the public service experience and satisfaction of elderly people through further research into the age-inclusiveness of signage systems design in healthcare facilities.

1.2 Problem Statement

The explosion of the elderly population aged 60 and above is now a widespread social phenomenon. Research has shown that in addition to the visible signs of aging, such as gray hair, wrinkles, and frailty, aging also affects cognitive abilities, and several functional areas, including memory, concentration, logical reasoning, and information processing speed, can change significantly with age (Ferguson et al., 2021;

Sánchez-Izquierdo & Fernández-Ballesteros, 2021; Sara J. Czaja et al., 2019; Seunghae, 2013; Wilson et al., 2020).These changes will bring a series of obstacles to the daily life of older adults and increase the burden on their families and the social geriatric care system (Beard et al., 2016; C. Chen et al., 2023; Han et al., 2020).

To better meet the challenges and opportunities, the World Health Organization proposes to improve the lives of older people by focusing on the design attributes of geriatric products to improve product usability (Y. Dong & Dong, 2023; Pan & Dong, 2023; Sara J. Czaja et al., 2019). Good design of services for the elderly can enhance the life satisfaction and well-being of the elderly population (Cristina et al., 2017; S. T. Ng et al., 2017; Sara J. Czaja et al., 2019). As previously mentioned, aging brings many physical and psychological changes that will hinder the mobility of elderly people (Ferguson et al., 2021; Michael K. Appeadu & Bruno Bordoni, 2023; Sánchez-Izquierdo & Fernández-Ballesteros, 2021; Sapmaz & Mujdeci, 2021; Sara J. Czaja et al., 2019; Seunghae, 2013; Wilson et al., 2020). One of the key challenges these changes pose for the elderly is wayfinding, especially in complex spaces like hospitals. Hospital wayfinding signage system design is an important aspect of healthcare facilities to enhance elderly people's quality of life, especially in China (Deng et al., 2024; J. Fan & Choi, 2023; B. Hu, 2023).

As the elderly are frequent hospital visitors, hospital signage is significant for them in wayfinding. An effective signage system helps to improve elderly people's ability to recognize the graphic symbols of the signage system, thus helping them to move quicker and more effectively in hospitals (M. S. Chen et al., 2021; En-I & Bebit, 2021; En-I et al., 2023; J. Fan & Choi, 2023; Hashim et al., 2014). As people getting older, their spatial navigation, spatial memory, and route learning abilities will deteriorate (Fricke et al., 2022; Head & Isom, 2010; Heward et al., 2023; Muffato et

al., 2022), having difficulty understanding signage (En-I et al., 2023; J. Fan & Choi, 2023; Y. Liu & Ho, 2012), and the acceptance of intelligent wayfinding devices also decreases (Ženka, Macháček, Krtička, et al., 2021), which makes wayfinding more difficult for the elderly.

However, hospitals are complex and multi-departmental spaces, it is a challenge to design effective signage symstem to convey wayfinding information for the elderly (En-I & Bebit, 2021; En-I et al., 2023; J. Fan & Choi, 2023; J. J. Foster & Afzalnia, 2005; Hashim et al., 2014; S. Lee et al., 2014). Most of the current signage systems in Chinese hospitals are designed according to the standards of healthy adults, lack standardized signage systems and universal design concepts, and are not well adapted to the needs of elderly users. According to the existing literature, this study summarizes the problems of the current Chinese hospital signage system into the following four aspects. (1) Hospital signage is not easy to recognize and understand (Gao, 2020; Gong, 2012; S. Lee et al., 2014; Qi & Chen, 2020; J. Wu et al., 2022; Y. Zhang, 2019). Signage design is not clear and ambiguous, such as the hospital outpatient hall general flow chart is incomplete or too complicated, some signage logo words are too small, not eye-catching, or lack or too little or not uniform or only words and no pictures to express. The reasonable organization of these elements can give the user a good overall feeling, but the current hospital guide signs in these form elements do not fully consider the actual needs of the elderly. (2) Hospital signage is not placed in a reasonable position (N. y. Wu, 2019; W. F. Zhang, 2019; Zhu et al., 2022), such as the stairway and elevator without the floor of the diagnosis and treatment department logo, individual clinic layout is not reasonable, resulting in frequent detours, increasing the number of inquiries. Inappropriate installation location will increase the space anxiety of the elderly to a certain extent, thus

increasing the difficulty of finding the way and making the medical experience of the elderly worse (Deng et al., 2024; B. Hu, 2023; Ji et al., 2008; Zhu et al., 2022). (3) Failure to maintain and update signage in a timely manner, old signs with confusing information can cause confusion and anxiety to users, and even lead to the wrong destination (Zeng et al., 2020; W. F. Zhang, 2019; Zhu et al., 2022). (4) Signage constructed using modern technology does not take into account the actual needs of the elderly; some electronic displays scroll too fast and have too much information, and some elderly patients have difficulties in using wayfinding APPs and digital maps (Xie & Zhou, 2023; M.-C. Zheng & Hsu, 2021). In addition ,there are few studies on hospital wayfinding for the elderly, the current research on wayfinding in healthcare facilities has focused more on elderly patients, ignoring other elderly companions, visitors, and elderly hospital staff; more research is needed to create a signage system that serves different elderly users (En-I & Bebit, 2021; Rodrigues et al., 2019).

The above shows that there is a gap between the existing signage systems in China and the needs of hospital users, especially the elderly. Overall, the literature on hospital signage systems in China emphasizes the importance of designing inclusive systems, especially for an aging population. Improvements in signage design and implementation are needed to meet the wayfinding needs of hospital users, especially the elderly. Therefore, determining the perceived and comprehensible nature of hospital signage for the elderly is critical to improving the current signage system (En-I & Bebit, 2021; J. Fan & Choi, 2023; Hashim et al., 2014). To address these issues, this study will improve the effectiveness of hospital signage systems for the elderly by investigating their perception and comprehension of existing hospital signage systems.

1.3 Research Objectives

To better identify the perception of the elderly population on the signage system and the level of comprehension of the healthcare symbols in Guangzhou's tertiary hospitals, this study aims to improve hospital signage system and hospital services for the elderly by evaluating users' perception and comprehension of the signage system in the selected tertiary hospitals in Guangzhou. In particular, this study is designed to achieve the following objectives. They are to:

1. To uncover the current situation and problems of the signage system in Guangzhou's tertiary hospitals.
2. To investigate the elderly people's perception of the signage system in Guangzhou's tertiary hospitals.
3. To examine the elderly people's comprehension of the healthcare symbols in Guangzhou's tertiary hospitals.
4. To provide design recommendations for hospital signage systems for elderly people's wayfinding.

1.4 Research Questions

Based on the research objectives, the following questions are addressed:

1. What are the current situation and problems of the signage system in Guangzhou's tertiary hospitals?
2. How do the elderly perceive the signage system in Guangzhou's tertiary hospitals?
3. How about the comprehensibility of healthcare symbols in Guangzhou's tertiary hospitals among the elderly?

4. What improvements to hospital signage systems would assist the elderly in wayfinding?

1.5 Significance of the Study

As mentioned, elderly people have difficulty in hospital wayfinding. They rely on signage systems more than younger people and have issues accurately identifying signage. Adequate wayfinding information can alleviate emotional stress and reduce the hidden financial and time costs of wasted time caused by wayfinding for the elderly. Creating such a signage system should be the desire of any hospital management administration, architect, and healthcare designer. It is necessary to review and evaluate the existing hospital signage system by investigating the usage requirements and perception of signage to improve wayfinding efficiency for the elderly.

Given the lack of significant research on the wayfinding effectiveness of the elderly, this study can provide an appropriate contribution to improving elderly wayfinding in the hospital:

The findings of this study will improve the effectiveness of hospital signage systems for wayfinding among elderly people. Investigating the usage requirements, perceived preferences, and the comprehension of the healthcare symbols of elderly people for hospital signage systems can provide a comprehensive evaluation of elderly-inclusive hospital signage systems and fill the gaps in previous wayfinding and theoretical studies in healthcare facilities to support further research. The suggested signage system will be helpful as a reference guideline for stakeholders, hospital administrators, and design agencies.

By highlighting the current situation and design flaws of the existing hospital signage system design for the elderly in China, this research helps to provide design recommendations for improving existing hospital signage systems. The knowledge generated from this study will help to improve the elderly's confidence in wayfinding and satisfaction with hospital services and enhance the experience of the elderly during their visits to the hospital.

In addition, this study will provide new perspectives for research on the management of healthcare organizations and the design of aging services. The results of this study will help the government to consider hospital signage systems as an important part of healthcare services, increase efforts to enhance hospital wayfinding information design, and ultimately provide more convenient healthcare services for the elderly. Other hospitals in China are expected to draw valuable knowledge from this study and use the hospital signage system in conjunction with the best practice examples presented in this study as a reference for improving hospital signage.

1.6 Scope of the Study

As mentioned earlier, Chinese tertiary hospitals are representative due to their comprehensive medical strength and high traffic flow, and this study will focus on this type of hospital as the research study site. A total of 3 tertiary hospitals will be selected randomly from Yuexiu District, Haizhu District, and Liwan District in Guangzhou City, as shown in Figure 1.5. The sampling site will be confined to the hospital area where the elderly are more frequently seen, such as the outpatient area, geriatric unit, neurology unit, and rehabilitation unit.

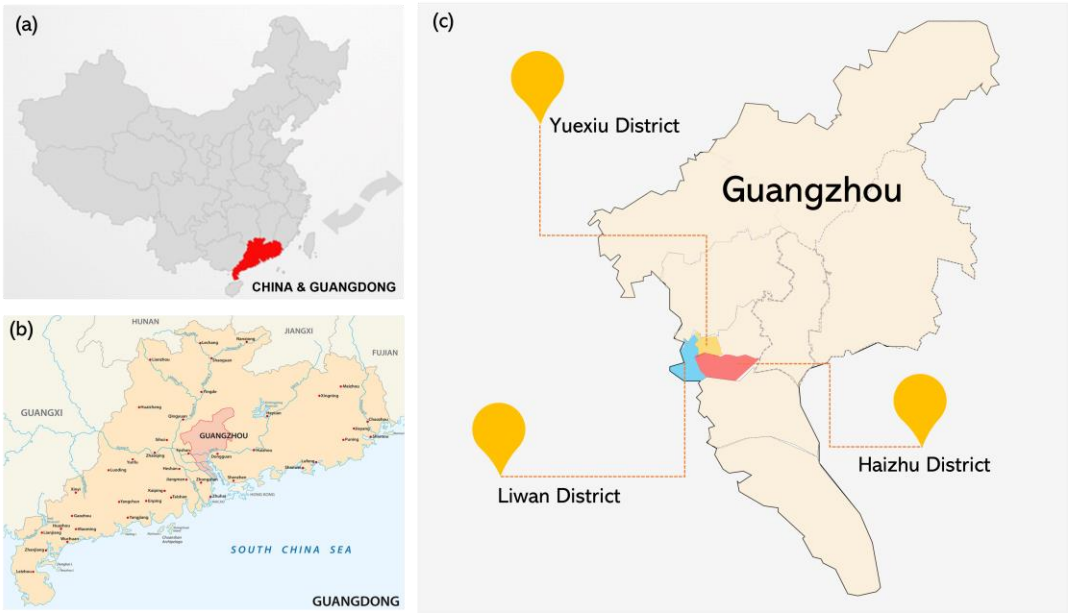


Figure 1.5 Locations of this study

Non-probability sampling methods were used for data collection, and mix-method was applied for data analysis. This study distributed 1000 questionnaires to elderly people aged above 65 years old in the selected hospitals. Three types of signage were considered in the questionnaires section: directional, regulatory, and identification. The symbol comprehensibility test was administered to 50 elderly people over 65 and 50 young people aged 18-40. This study collected the 42 most frequently used healthcare symbols in the selected tertiary hospitals for symbol comprehension testing.

1.7 Limitations to the Study

However, this study still has many limitations due to objective conditions such as study time, budget, and Covid-19, as well as uncontrollable factors caused by the study methods.

One of the main limitations of this study is the research methodology, which tends to favor traditional empirical research. Empirical research emphasizes that

things are measurable and quantifiable (Velte & Stawinoga, 2017), but not all issues in wayfinding research can be precise. This can easily lead to the study being formal and not in-depth (Hallinger, 2011; Velte & Stawinoga, 2017); for example, it is difficult to quantify the data in the questionnaire to reveal elderly users' disorientation point in hospital and why they get lost. In addition, the government control policies during the outbreak made it difficult for us to execute experiments on user route tracking and action research in hospitals. Route tracking helped capture the locations where users experienced wayfinding problems in the hospital and users' use of signage and further incorporate users' actual wayfinding experiences into the participatory design process (Y. Liu & Ho, 2012; O'Neill, 1991; Peponis et al., 1990).

In addition, the number and type of older adults who participated in the questionnaires and tests of this study. Some potential respondents were unwilling to complete the questionnaire or to share their experience of finding their way in the hospital due to time constraints or anxiety. This situation may interrupt some questionnaires and reduce the number of valid questionnaires to some extent. However, a larger sample size and more validated samples in the study could further strengthen the results and findings. Also, this study did not differentiate between categories of respondents. As some of the respondents may be regular visitors to the hospital while some of them are first time visitors to the hospital. Their perception and frequency of use of hospital signage is different.

Moreover, due to time and budget constraints, this study could not cover all tertiary hospitals in Guangzhou. Only 3 out of 42 tertiary hospitals in Guangzhou were selected as study sites. The results of this study only represent some elderly people in Guangzhou and some large public general hospitals in Guangzhou and cannot represent hospitals in other regions and countries. Although this study provides

recommendations for improving the common problems of the signage systems in the three hospitals, there are also individual problems in each hospital, which may be related to the variability of the hospital's environment, building structure, consultation process, and the characteristics of the users themselves. Therefore, this study cannot provide perfect recommendations for improvement for every hospital.

1.8 Definition of Key Terms

Wayfinding

In the book "The Image of the City," Kevin Lynch used the term (originally "way-finding"), where he defined way-finding as "a consistent use and organization of definite sensory cues from the external environment (K. Lynch, 1960)."

The definition of "wayfinding" from Passini's book “Wayfinding in Architecture”: "Wayfinding is the process of using environmental information to orient oneself, to navigate through space and to locate destinations in the environment. It is a complex cognitive activity that is dependent upon a range of factors, including the observer’s perceptual abilities, his or her familiarity with the environment, the amount and quality of available environmental information, and the complexity of the spatial problem to be solved (R. Passini, 1984)."

Tertiary Hospital

A tertiary care hospital (tertiary hospital) is the highest level of the "three grades and six grades" classification of hospitals in mainland China. It is defined as large public hospitals providing medical and health services across regions, provinces, cities, and the country. Moreover, it is a medical and preventive technology center with comprehensive medical, teaching, and research capabilities and 500 or more inpatient beds. Grade A: According to the thousand-point system, the grade rating

standard obtains more than 900 points as Grade A (National Health Commission of the People's Republic of China, 1989).

Signage System

A signage system, in general, is a method of providing wayfinding information. According to the American Institute of Graphic Arts (AIGA), the definition of signage system design is a visual design that provides identification, guidance, explanation, warning, and other functions through the combination of words, patterns, and colors (Calori & Vanden-Eynden, 2015b).

Symbol

"A symbol is an object or a sign that stands for or represents something else, especially an object or idea that is abstract or difficult to visualize. A symbol differs from an icon or an index in that it does not physically resemble the object or idea it represents. Rather, its meaning is derived from convention or agreement among particular cultural or linguistic community members. Symbols can be words, images, or other forms of representation, and their meanings can vary depending on the context in which they are used (Burks, 1949)."

Healthcare Symbols

The International Organization for Standardization (ISO) defines healthcare symbols for wayfinding as graphical symbols that provide directional information and guidance to patients, visitors, and staff in healthcare facilities. These symbols are intended to be easily recognizable and understood and are typically used in signage and other wayfinding materials to help people navigate healthcare environments. The source of this definition comes from the ISO website, specifically from the ISO 3864-4:2011 - Graphical Symbols - Safety colors and safety signs - Part 4: Colorimetric and photometric properties of safety sign materials standard (Iso 3864-4:2011, 2011).

Aging

"The aging process is a biological reality which has its dynamic, largely beyond human control. However, it is also subject to the constructions by which each society makes sense of old age. In the developed world, chronological time plays a paramount role. The age of 60 or 65, roughly equivalent to retirement age in most developed countries, is said to be the beginning of old age. In many parts of the developing world, chronological time has little or no importance in the meaning of old age. Other socially constructed meanings of age are more significant, such as the roles assigned to older people; in some cases, the loss of roles accompanying physical decline is significant in defining old age. Thus, in contrast to the chronological milestones that mark life stages in the developed world, old age in many developing countries begins when people's active contribution is no longer possible(Mark Gorman, 2017)."

Elderly People

The United Nations defines "older persons" or "elderly people" as individuals who are 65 years of age or older (United Nations Department of Economic and Social Affairs, 1958).

Perception

According to Lewis, "Fundamental to perception is that there is an experiencing person or perceiver; secondly, that something is being perceived (either an object, person, situation or relationship); thirdly, there is the context of the situation in which objects, events or persons are perceived and finally there is the process nature of perception starting with the experiencing of multiple stimuli by the senses and ending with the formation of percepts (Lewis, 2001)".

Visual Perception

According to Riesenhuber, M., & Poggio, T., "Visual perception refers to the ability of the brain to extract meaningful information from visual stimuli to guide behavior. It involves processing visual features such as color, shape, motion, and depth, as well as integrating these features into higher-order representations of objects and scenes. Visual perception is essential for various activities, from basic survival behaviors such as avoiding obstacles and finding food to complex social interactions and artistic expression(Riesenhuber & Poggio, 2002)."

1.9 Organization of Chapters

This chapter presents the essential challenges of wayfinding in large hospitals in the context of China's aging population, particularly in large cities with high population density, such as Guangzhou. The study focuses on the problem of understanding healthcare symbols in hospital signage systems by the elderly population. It provides an extensive review of how hospital signage systems work for wayfinding. This chapter also presents the results of the preliminary study and the extended preliminary study, as well as the problem statement. This led to the research objectives and questions. This chapter also describes the significance of the study and presents definitions of critical terms for the variables examined in this study.

Chapter 2 reviews the literature on hospital wayfinding, wayfinding for the elderly, hospital signage systems, and other variables examined in this study, discusses vital concepts derived from previous research, and develops the research framework and research hypotheses.

Chapter 3 describes the research methodology applied in this study. It outlines the research design, the study population and sample, the measurement of variables, data collection methods, and data analysis tools.

Chapter 4 and 5 presents the results of the questionnaire and symbol comprehensibility tests, discusses the results, and includes a descriptive analysis of the demographic profile of the older adults who participated in the study. T-tests and correlation analyses were conducted to explore whether there were differences in the perceptions, personal preferences, and understanding of healthcare symbols by gender, education level, and age of the elderly participants concerning the hospital signage system. A symbol comprehensibility test was used to obtain the degree of rationality of older adults regarding the healthcare symbols in the hospital signage system. In addition, Pearson correlation analysis was used to examine the relationship between hospital signage system characteristics and participant performance.

Finally, this study concludes with Chapter 6, which summarizes the results of the study. The findings are explained and discussed, and the implications of this study are presented. In addition, Additionally, design recommendations are made for age-friendly hospital signage design, and suggestions for future research are provided.

1.10 Summary

Chapter 1 introduces the research area and outlines the background of this study. It briefly reviews the development of hospital wayfinding and hospital signage systems. The chapter also describes the purpose of this study and identifies the importance and limitations of this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In the last decade, the research literature in the field of wayfinding has grown, and the easiness of hospital signage systems to be perceived and comprehended by users is one of the key factors for successful wayfinding, especially for the elderly people. This chapter reviews the relevant literature used to formulate the theoretical framework for the present study. This section begins with an overview of the research related to wayfinding and wayfinding in healthcare environments, followed by the aging phenomenon in China and the characteristics of elderly people's wayfinding. Then an analysis of the role of signage systems in wayfinding and the healthcare symbols outlines the design elements of signage systems, the role of hospital signage systems for wayfinding, and the understanding of healthcare symbols in signage systems among the elderly population. Finally, a theoretical framework and hypotheses are developed and presented towards the end of the chapter. Figure 2.1 demonstrates the framework of the literature review for this study, containing the basic concepts and keywords.

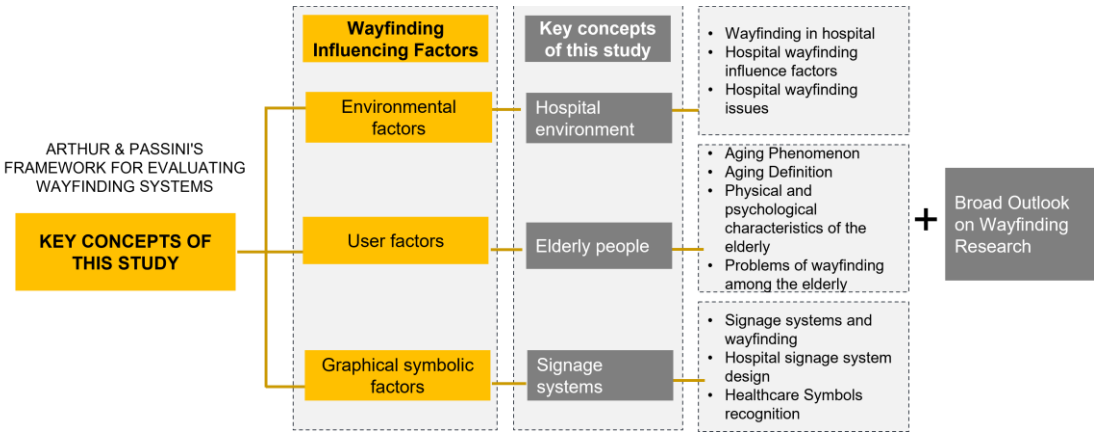


Figure 2.1 Framework of the literature review for this study

2.2 Broad Outlook on Wayfinding Research

2.2.1 Wayfinding research and development

"Wayfinding" originated from nautical survival training and refers to finding a destination in an unfamiliar environment (Gong, 2012; Hatice Şeyma SELBESOĞLU et al., 2021). The definition of wayfinding varies between scholars in different fields. In the 1960s and 1980s, researchers such as Kevin Lynch, Downs & David Stea, and Passini combined cognitive psychology and environmental psychology theories with wayfinding behavior. They studied how people get lost and find their way through cognitive and perceptual processes after getting lost and finally redefined wayfinding by incorporating cognitive psychology into wayfinding behavior (Gong, 2012; Yesiltepe et al., 2021; W. F. Zhang, 2019).

The term "wayfinding" was first coined by Kevin Lynch in the 1960s (Iftikhar et al., 2020; K. Lynch, 1960; Yesiltepe et al., 2021). In the book "The Image of the City," Kevin Lynch points out that people perceive urban space through symbolic orientation elements. In this book, he introduces the concept of "wayfinding," and the term was used to describe how a person navigates a city using an internal memory structure, which could be referred to as a cognitive map with five elements: paths, nodes, districts, edges, and landmarks (K. Lynch, 1960). After that, several studies employed this buzzword, and cognitive research related to wayfinding expanded his static concept of spatial orientation into a dynamic understanding of wayfinding. Downs & Stea pointed out that the wayfinding process consists of four following stages: a) orientation, to indicate when a person recognizes where he/she is for nearby landmarks and the desired destination; b) route selection, when a person chooses a way to reach the desired destination; c) route control, to constantly monitor and

confirm that the person is following the correct direction; and d) recognition of destination, to realize that he/she has reached the desired destination (Downs & Stea, 1973). Passini described “Wayfinding” as the human ability to reach a destination in unfamiliar and familiar environments and is fundamentally a decision-making process (Arthur & Passini, 1992; R Passini, 1981, 1996; R. Passini, 1984). In the paper “Wayfinding: A Conceptual Framework” Passini suggested that wayfinding referred to a person's ability to reach a spatial destination based on spatial cognition and was a dynamic process involving purposive mobility (R Passini, 1981). Importantly, the paper identified three distinct aspects of wayfinding, including information processing, decision-making, and decision execution, as well as some fundamental principles of spatial problem-solving (R Passini, 1981). According to the paper “Wayfinding Design: logic, application, and some views on Universality,” wayfinding encompasses all mental processes involved in purposeful mobility (R Passini, 1996). Two aspects of wayfinding design were examined, including 1) the spatial components of wayfinding design, such as spatial organization and circulation systems, and 2) the communication components of wayfinding design, such as architectural and graphic communication (R Passini, 1996). Wayfinding includes identifying routes, learning routes, and retracing or reversing routes from memory, it is the ability to reach a particular destination by some means and recognize the target when someone approaches the location (C. H. Chen et al., 2009; Hegarty et al., 2023; Iftikhar et al., 2020; Yesiltepe et al., 2021). The definition of wayfinding varies among scholars in different fields, and the definitions of wayfinding collected in this study are organized in the following table (Table 2.1).

Table 2.1 The definitions of Wayfinding in different fields

Author/s	Subject area of the study	Definitions
Lynch (1960)	Architecture	Wayfinding is based on "a consistent use and organization of definite sensory cues from the external environment"(p. 3)
Downs and Stea (1973)	Geography	The wayfinding process includes the four following stages: a) orientation, to indicate when a person recognizes where he/she is to nearby landmarks and the desired destination; b) route selection, when a person chooses a way to reach the desired destination; c) route control, to constantly monitor and confirm that the person is following the correct direction: and d)recognition of destination, to realize that he/she has reached the desired destination.
Passini (1987)	Architecture	Wayfinding is "spatial problem solving that comprises three major processes: information processing, decision making, and decision execution or the initiation of movement in space comprising a behavioral and (spatial) environmental components (p.64)
Chown et al.(1995)	Psychology	Wayfinding involves four tasks: landmark identification: direction selection, path selection, and environmental abstraction.
Algase et al.(2007)	Psychology	Wayfinding is a cognitive process that requires information from the physical environment and from the knowledge base (cognitive map) of the way finder" (p. 1017)
Farr et al. (2012)	Social science	Wayfinding is the process of finding your way to a destination in a familiar or unfamiliar setting using any cues given by the environment (p. 716)
Montello and Raubal (2012)	Geography	Wayfinding process includes the following three steps: a) to create and choose a route: b) to establish and maintain orientation with respect to one's starting location, external features, or places; and c) to recognize landmarks in the environment.

Depending on the size and spatial scale, wayfinding environments can be broadly classified into two categories: indoor environments and outdoor environments (Hund & Padgitt, 2010), see Figure 2.2. Kevin Lynch's research on wayfinding was confined to urban design but did not go further to introduce the theory of wayfinding