Cognitive Load Theory Analysis of Medical Signage System for Seniors Based on General Hospitals in Shanghai

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Abstract. The changing demographic structure of the population has sparked increased interest in geriatric programs and industries. Among these concerns, the pressing matter of mitigating the cognitive load among the seniors within medical environments and guaranteeing their seamless and secure access to medical services through signage systems has emerged as an exigent issue. This study focuses on three comprehensive hospitals in Shanghai and is grounded in the cognitive load theory and the cognitive characteristics of the seniors. It employs literature analysis and qualitative research methods to investigate the design issues and improvement directions of medical signage systems for the seniors. The research findings reveal that the senior's population generally experiences a higher cognitive load when using medical signage systems. This is primarily evidenced by difficulties in comprehending signage information and swiftly recognizing crucial details, highlighting deficiencies in signage system design. Accordingly, this study presents recommendations tailored to the senior's population to reduce their cognitive load, enhance the overall usability, and improve the accuracy of medical signage systems. Additionally, this research offers insights and discussions regarding the application of cognitive load theory in the field of design.

Keywords: Cognitive Load · Medical Signage System · Seniors · Wayfinding

1 Introduction

Research background and purpose: The ageing population is a powerful and transformative demographic force [1]. The World Health Organization (WHO) has advocated the importance of developing age-friendly environments by introducing the principles of proactive age-friendly healthcare [2]. Medical environments as one of the important environments essential to an aging society, should provide aging-friendly medical spaces and safe and comfortable medical environments for the seniors. As a vital component of medical environments, medical signage systems play a pivotal role in conveying medical information, guiding patients, and ensuring patient safety. However, due to the decline

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in the functions of various tissues and organs of the seniors, the perceptual and cognitive abilities gradually deteriorate, which affects the perception of space, spatial cues, and signage to varying degrees. Inadequate design of medical signage systems can exacerbate the cognitive load on senior individuals, causing unnecessary distress and risks. This study aims to explore the cognitive load issues faced by the senior when using medical signage systems and proposes corresponding improvement recommendations to reduce cognitive load and enhance the usability and accuracy of these systems.

Based on the Cognitive Load Theory and the cognitive characteristics of senior individuals, we conducted an evaluation and analysis of exemplary medical signage system designs. Employing literature analysis and qualitative research methods, we delved into the current state of medical signage systems in three general hospitals in Shanghai, summarizing prevalent issues, and offering improvement recommendations. The aim is to alleviate cognitive load among the senior and enhance their medical experience.

2 Theoretical Background

2.1 Cognitive Load Theory (CLT)

In the late 1980s, educational psychologist John Sweller developed cognitive load theory out of a study of problem solving [3]. Cognitive load theory refers to the total amount of mental activity imposed on an individual's cognitive system during a given operational time (Sweller 1988). The cognitive resources of an individual are limited, seniors need to consume a certain number of cognitive resources to complete the wayfinding task in the medical space. If the cognitive resources consumed in completing the task exceed the total cognitive resources that an individual has, it will cause cognitive load.

John Sweller stated that the basic goal of cognitive load theory is to reduce extrinsic load. Researchers, represented by John Sweller et al. have classified cognitive load into three categories, namely intrinsic cognitive load (ICL), extraneous cognitive load (ECL), and germane cognitive load (GCL), based on the source and nature of the main factors influencing cognitive load [4].

Intrinsic Cognitive Load (ICL). Refers to the inherent level of mental effort or cognitive processing required by an individual to understand and process a specific task or information. It is associated with the inherent complexity of the task or content itself, regardless of how it is presented or organized. [5, 6]. In an unfamiliar medical space, the wayfinding task itself is difficult, and if the information of the signage system is too complex and beyond the knowledge reserve of the Seniors, there is a risk of working memory burden and higher cognitive load.

Extraneous Cognitive Load (ECL). Refers to the cognitive load that is imposed on an individual due to the way information or tasks are presented or organized [5]. I posit that the environmental context surrounding the signage system, alongside the layout and color schemes employed in the wayfinding system itself, represents one of the foremost factors influencing the external cognitive load experienced by seniors. Substantiation of this hypothesis will be undertaken in the subsequent sections of this discourse.

Germane Cognitive Load (GCL). A concept in cognitive load theory that refers the cognitive effort directly related to the acquisition and integration of new information or skills [8]. In the design of medical signage systems, how to reduce the germane

cognitive load to enhance the wayfinding experience of seniors in complex healthcare environments will be discussed in the following sections.

2.2 Cognitive Characteristics of the Seniors

Cognition refers to the mental processes and activities related to acquiring, processing, storing, and using information. It encompasses a wide range of mental processes, including perception, attention, memory, language, problem-solving, decision-making, and reasoning, among others. Essentially, cognition is how the brain processes and makes sense of the world around us and the information we receive through our senses [7].

Salthouse and others proposed the Theory of Age-Related Differences in Cognitive Processing Speed in 1966. The core of this theory is that as individuals age, their cognitive processing speed gradually declines [9]. Hasher, Stoltzfus, Zacks and Rypma proposed the inhibition theory of cognitive ageing, which states that as individuals age, it becomes increasingly difficult for them to focus on target information and to inhibit attention to irrelevant information [11]. Irrelevant information occupies the capacity of cognitive resources, and the diminished ability of the seniors to suppress irrelevant information increased cognitive load due to difficulty concentrating.

Craik and Byrd suggested that older people experience cognitive decline because they lack an ability to 'self-initiate processing', as expressed in working memory, which researchers have since termed working memory theory [12]. Decreased attention and working memory make it take older people more time and effort to complete a task, and they are more likely to be distracted during the task, affecting visual search performance interfering with working memory and causing cognitive lapses [13]. The deterioration of working memory capacity and coding storage capacity prevents seniors from processing information reasonably efficiently at work and increases the working memory load.

Lindenberger and Baltes (1994) found that basic audio-visual sensory functions have strong explanatory power for cognitive ageing [10]. With age, visual acuity decreases, and the cornea undergoes changes, leading to reduced sharpness of vision, affecting color discrimination, and causing a reduction in the field of view.

It is evident that with advancing age, physiological changes in the human body lead to cognitive impairments, characterized by diminished sensory capabilities, slower cognitive processing speed, reduced attention and memory, and a decline in information processing abilities, among other factors.

2.3 Medical Signage System Design

In general, older people have greater symbol comprehension problems than younger people (Lesch 2003; Shorr et al. 2009; Kim et al. 2009) [14–16]. A well-designed signage system together with other environmental features, appropriately designed for the target audience, can help orientate them and prevent confusion, frustration, stress, and even time losses [16]. Reduces difficulties and stress associated with the wayfinding tasks, and consequently help in health treatments and recovery [16]. To provide users with an effective wayfinding signage system, Rousek and Hallbeck, suggest that signage design must consider four factors to be effectively designed, signage recognition, signage color, signage font type, Americans with Disabilities Act guidelines [17].

3 Reference Cases of Well-Designed Medical Signage System

Based on the theoretical background, three representative medical signage system cases have been selected according to the nine effective medical signage design categories proposed by Rodrigues et al. (2019). (1. Text formatting; 2. Information hierarchy and density; 3. Language and terminology; 4. Symbols and pictograms; 5. Colors; 6. Placement, dimensions and typology; 7. Illumination, visibility and legibility; 8. Standardization; 9. Inclusivity and user characteristics), and they are subjected to an efficacy analysis [18].

3.1 Humber River Hospital

Located in Toronto. At the time of launch it was the largest hospital in Canada and the first fully digital hospital in North America. Hospital signage system introduces the design concept of airport signage, which is uniform in style, simple and sharp with strong colors. The color-coded visual system is carried out through wall and ceiling treatments, maps, directional signs, and digital signage. The surrounding environment is clean and tidy, free of irrelevant information, reducing the external load brought to the seniors by the environment, which allows seniors patients and visitors to easily identify their destination. For an analysis of the effectiveness of the signage system see Table 1.

Table 1. Humber River Hospital Signage System Analysis

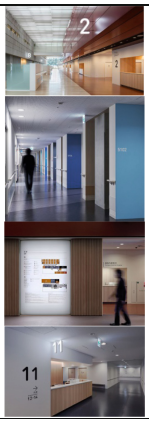
Categories	Analyze	Figure
Text formatting	Information layout is clear, left-aligned, sans-serif font, clear font size contrast, and high readability.	
Information hierarchy and density	Clear, information listed according to importance and highlighted using color and font to emphasize primary or secondary information.	
Language and terminology	No long sentences, medical abbreviations, or difficult words were used to reduce the intrinsic cognitive load.	
Symbols and pictograms	Public icons and pictograms are clear and easy to understand.	
Colors	Using color variations for segmentation enhances information segregation and reduces extraneous cognitive load.	
Placement, dimensions, and typology	Incorporating airport signage design concepts enables older individuals to intuitively grasp sign information from various directions.	
Illumination, visibility, and legibility	Abundant natural lighting was utilized, without the use of reflective materials, resulting in high visibility and readability.	
Standardization	The signage system is friendly for seniors and people with disabilities.	
Inclusivity and user characteristics	A digital wayfinding strategy has been developed to facilitate access for seniors and persons with disabilities.	

3.2 Home - Tachikawa General Hospital

It is a comprehensive medical facility located in Tachikawa, Japan. The signage system's design received the Japan Sign Design Association (SDA) Excellent Award in 2017. The signage system features a large, mall-like space as its backdrop, with floating white

numbers drawing attention. As senior pass the reception desk, they can easily discern their directions and locations at a glance. The walls, ceilings, lighting, and flooring exhibit a variety of colors and materials. The signage system demonstrates remarkable effectiveness, boasts high utilization, and excels in user-friendliness (see Table 2).

Table 2. Home - Tachikawa General Hospital Signage System Analysis

Categories	Analyze	Figure
Text formatting	Information layout is clear, left-aligned or right-aligned, rounded sans-serif font, numbers vs. text, graphics vs. text size contrast is evident.	
Information hierarchy and density	In situations where the information hierarchy is the same, there is higher information density with less emphasis on key information.	
Language and terminology	No long sentences.	
Symbols and pictograms	Public icons and pictograms are clear, easily understandable, and frequently used.	
Colors	Use of color variations for spatial segmentation to enhance cognitive memory.	
Placement, dimensions, and typology	Floating signage for clarity, People are surrounded by signage information at an appropriate height whether they are standing or sitting.	
Illumination, visibility, and legibility	Part of the guide as a whole is a light box, which serves both illumination and guidance. The lighting around the wall signs is soft and non-glaring.	
Standardization	The signage system is friendly for seniors and people with disabilities.	
Inclusivity and user characteristics	The environment is clean and tidy and easy for the elderly and disabled to orient themselves, but there is no other digital signage system.	

3.3 Signaletik SLK-Kliniken Heilbronn

SLK-Kliniken Heilbronn GmbH operates three acute hospitals and a geriatric rehabilitation clinic. The medical signage system combines colors, letters, numbers, and icons in a harmonious and highly functional guidance system. Among other things, complex guiding information is transformed into precise elements and iconographic symbols. These principles are coded as letters for building parts and numbers for stores and lead through the hospital in the form of icons. The signage system is fully accessible for the seniors and disabled (Table 3).

Through the analysis of medical signage systems in three hospitals, it was observed that effective signage systems for the elderly, aimed at reducing cognitive load during navigation, typically employ sans-serif fonts, employ left-aligned and right-aligned text layouts, incorporate a multitude of pictorial symbols, high-contrast colors, avoid lengthy sentences and abbreviations, and adhere to standardized design principles.

Table 3. SLK-Kliniken Heilbronn GmbH Signage System Analysis

Categories	Analyze	Figure
Text formatting	Information layout is clear, left-aligned or right-aligned, sans-serif font.	
Information hierarchy and density	Clear, information listed according to importance and highlighted using color to emphasize primary or secondary information.	
Language and terminology	No long sentences, medical abbreviations, or difficult words were used to reduce the intrinsic cognitive load.	
Symbols and pictograms	Custom pictograms are clear, easily understandable, and frequently used. The overall impression is completed by wall paintings, foil plots, and foil signs.	
Colors	Colorful, Use of color variations for spatial segmentation to enhance cognitive memory.	
Placement, dimensions, and typology	The ceiling signage and the wall signage are installed in a reasonable position and in the right size, making it easy to be viewed by any group of people.	
Illumination, visibility, and legibility	The circular target points of the illuminated tracks have been adjusted in color, size, and typography to meet the needs of severely visually impaired individuals using the Visually Impaired Simulator from ABSV. Resulting in high visibility and readability.	
Standardization	Signage System fonts have been developed in accordance with accessibility standards.	
Inclusivity and user characteristics	The font "Neue Frutiger 1450" was first developed in accordance with the new accessibility regulation DIN 1450 in 2013. Barrier-free orientation is supported by 60 tactile handrail signs.	

4 Selected Case Studies - Three General Hospitals in Shanghai.

Different countries and regions may face unique challenges and limitations in the healthcare sector. To gain further insights, we conducted an in-depth analysis of the wayfinding systems in three comprehensive hospitals in China, shedding light on potential issues. Through on-site investigations and interviews at top-tier hospitals in first-tier Chinese cities, we selected three Shanghai-based comprehensive grade 3 hospitals for the analysis, based on criteria such as citizen satisfaction, medical standing, and influence. These hospitals include Longhua Hospital affiliated to Shanghai University of Traditional Chinese Medicine (A), Zhongshan Hospital affiliated to Fudan University (B) and Huashan Hospital affiliated to Fudan University (C). The analysis of the signage systems of three hospitals was conducted based on the nine effective medical signage design categories proposed by Rodrigues et al. The analysis is as follows.

4.1 Longhua Hospital Affiliated to Shanghai University of Traditional Chinese Medicine (A)

Through conducted personal visits and on-site research, it became evident that the hospital environment exhibited signage of slight aging, with noticeable modifications and patches on the signage system. While the signage boards displayed a wide variety of types, their abundance and diverse color palette, when not used judiciously, led to visual clutter. A detailed analysis is presented in Table 4.

Table 4. Shanghai Longhua Hospital Affiliated to Shanghai University of Traditional Chinese Medicine Signage System Analysis

Categories	Analyze	Figure
Text formatting	The use of sans-serif font is observed; however, the alignment is ambiguous, the font size is diminutive, the strokes are fine, spacing between characters is excessively cramped and inconsistent, and there is an absence of utilizing font stroke thickness variation to distinguish information.	
Information hierarchy and density	The signage is excessively crowded and cluttered, with information hierarchy primarily differentiated by color coding; however, the organization of information layers lacks clarity.	
Language and terminology	Department titles are easily understandable, with no use of abbreviations, although some lengthy technical terms are present.	
Symbols and pictograms	Public symbols are used sparingly, and pictograms are not used.	
Colors	Utilizing blue and orange as the unified color palette with variations in similar hues within this spectrum, the presence of multiple colors on signage has the potential to induce visual confusion.	
Placement, dimensions, and typology	The signage varies in terms of size and placement, which can sometimes lead to inconsistency.	
Illumination, visibility, and legibility	The signage is generally well-lit, ensuring good visibility, but legibility com-promised due to smaller text.	
Standardization	There is room for improvement in standardization, as some signs deviate from the established design norms.	
Inclusivity and user characteristics	The signage information is not user-friendly for senior individuals or visually impaired patients. The digital registration system in place, but it is used less frequently by seniors, with the majority of users being younger individuals.	

4.2 Zhongshan Hospital Affiliated to Fudan University (B)

The overall design of the signage system maintains a uniform style, demonstrating consistency in typography, text, and color. However, it exhibits a slightly outdated appearance, and there are concerns regarding the sustainability of the signage. Notably, the system lacks the capability to rectify information errors, which could have implications for its aesthetic appeal. A detailed analysis is presented in Table 5.

4.3 Huashan Hospital Affiliated to Fudan University (C)

The overall design style of the signage system is consistent, featuring the hospital's branding, which contributes to building the brand image. The signage in the Convenience Service Center incorporates a small number of graphic elements, enhancing text comprehension. The color scheme is uniform and eye-catching, ensuring high readability. A detailed analysis is presented in Table 6.

An effectiveness analysis of the signage systems in three Shanghai general hospitals was conducted through on-site investigations and observational analyses, revealing several common issues. In terms of design, the signage systems of these hospitals exhibited a similar design style. Text formatting, typography, and colors were consistent, reflecting a more standardized design. However, these systems heavily relied on text-based information, with a lack of development and utilization of symbols and pictograms, posing challenges for elderly individuals in comprehending the provided information.

Table 5. Zhongshan Hospital Affiliated to Fudan University Signage System Analysis

Categories	Analyze	Figure
Text formatting	Information layout is clear, left-aligned or center-aligned, sans-serif font. Letter spacing and line spacing are wide, ensuring high readability.	
Information hierarchy and density	Information hierarchy primarily differentiated by color coding; however, the organization of information layers lacks clarity.	
Language and terminology	Multiple instances of highly specialized terminology and abbreviations are used.	
Symbols and pictograms	Public symbols are used sparingly, and pictograms are not used. There are mural walls in the corridors that can enhance the memory of senior individuals.	
Colors	Using blue as the unified color tone, variations in brightness are applied within the blue range to emphasize information.	
Placement, dimensions, and typology	The ceiling signage and the wall signage are installed in a reasonable position and in the right size, making it easy to be viewed by any group of people.	
Illumination, visibility, and legibility	Indoor lighting is sufficient, the wall signage materials are non-reflective, and the ceiling signage materials are self-illuminating, ensuring high visibility and readability.	
Standardization	There is room for improvement in standardization, as some signage information deviate from the established design norms.	
Inclusivity and user characteristics	The signage information features large text, bold strokes, and wide spacing, making it convenient for elderly or visually impaired individuals to read. There is also a voice broadcasting system in place.	

Table 6. Huashan Hospital Affiliated to Fudan University Signage System Analysis

Categories	Analyze	Figure
Text formatting	Information layout is clear, left-aligned, sans-serif font, high readability.	
Information hierarchy and density	Information hierarchy is distinguished through color coding and enlarged fonts, but the organization of information layers within the same area lacks clarity.	
Language and terminology	No long sentences, medical abbreviations, or difficult words were used to reduce the intrinsic cognitive load.	
Symbols and pictograms	Pictograms are used at elevator locations and service centers, aiding recognition, and memorization.	
Colors	The use of red as a unified color scheme creates both consistency and cohesion.	
Placement, dimensions, and typology	The ceiling signage and the wall signage are installed in a reasonable position and in the right size, making it easy to be viewed by any group of people. However, due to the less-than-tidy surroundings, they appear somewhat cluttered.	
Illumination, visibility, and legibility	Indoor lighting is sufficient, the wall signage materials are non-reflective, and the ceiling signage materials are self-illuminating, ensuring high visibility and readability.	
Standardization	There is room for improvement in standardization, as some signage information deviate from the established design norms.	
Inclusivity and user characteristics	There is a voice broadcast system and electronic screens available, which facilitate the usage for senior individuals as well as those with visual or hearing impairments.	

Some textual information was positioned outside the normal visual range, leading to readability issues. While the color scheme was uniform, it lacked differentiation based on functional areas or department categories, necessitating additional time and cognitive effort from senior individuals to understand relevant information, thereby increasing cognitive load. The signage systems featured a variety of signage types, contributing to information overload and higher memory demands for senior users. Additionally, the

surrounding environment planning for these systems appeared suboptimal, frequently presenting irrelevant information that could divert the attention and impair the memory of senior individuals.

To comprehensively assess the practical effectiveness of the signage systems, we conducted interviews with 10 senior participants in each of the three comprehensive hospitals. These interviews aimed to gather their perspectives on the signage systems. The interview questions are outlined in Table 7.

Table 7. Interview Questions

Questions No	Questions
Q1	Your age and level of education?
Q2	Do you frequently use the signage system within the hospital?
Q3	Has the signage system been helpful to you in finding your way?
Q4	Have you ever encountered situations where the signage system was difficult to understand? Can you share some examples?
Q5	Which signage elements do you find the easiest to understand and use?
Q6	Do you have any suggestions or recommendations for improving the signage system's friendliness towards senior citizens?

Through interviews with seniors, we have gained valuable insights into the medical signage system. The interviewees had an average age of 69 years and varied levels of education. During the interviews, it was observed that more than 50% of the seniors frequently utilize the signage system and acknowledge its functionality and effectiveness. However, some expressed concerns regarding the legibility of the floor indices, noting that the text was too small to read. They emphasized that larger fonts, simplified symbols and text, and distinct colors were immensely helpful for wayfinding. A minority of the seniors mentioned that the abundance of signage throughout the hospital could be overwhelming, leading to confusion about which signage to follow. In such cases, they relied on healthcare staff for guidance. These insights provided by seniors have been instrumental in enhancing our understanding of practical issues with the signage system.

5 Design Suggestions to Reduce Cognitive Load in the Senior

Based on the definitions and characteristics of the three cognitive load types mentioned earlier, we have categorized the 9 effective medical signage design categories proposed by Rodrigues et al. into their respective cognitive load types. This categorization enables us to provide more specific and targeted improvement recommendations for each category, thereby better mitigating cognitive load for older adults. Additionally, in conjunction with the strengths identified in three successful case studies, we have established practical exemplars for the design of medical wayfinding systems. These exemplars not only serve to validate our proposed recommendations in practice but also ensure their

feasibility and real-world effectiveness. Specific design recommendations are shown in Table 8.

Table 8. Design Suggestions to Reduce Cognitive Load in the Senior

Type	Categories	Design Suggestions
Intrinsic Cognitive Load (ICL)	Information hierarchy and density	1) To avoid signage overload or the absence of valuable information, careful planning of sign types and their frequency of use is necessary. Avoid signs that are overly dense, inconsistent, or cluttered 2) Information should be organized hierarchically, listing items by importance, and emphasizing primary and secondary information through font size, thickness, proportion, and color contrast 3) The arrangement order of destinations in signage should align with the actual spatial arrangement 4) Modularize the information hierarchy into groups and increase the spacing between groups
	Language and terminology	1) Avoid using long sentences, abbreviations, and highly technical terms. Use short sentences that are easier to understand and memorize 2) Distinguish the terms with the help of different typeface weights, text, color Recommend combining text with graphics
Extraneous Cognitive Load (ECL)	Text formatting	1) Utilize a bold sans-serif font such as Frutiger, Univers or Helvetica; emphasize information through variations in font size and thickness; Choose left-aligned or right-aligned text alignment and avoid center alignment 2) Ensure that the height of letters falls between 75% and 100% of their width. Maintain consistent spacing between Chinese characters and between Chinese characters and English characters

(*continued*)

Table 8. (*continued*)

Type	Categories	Design Suggestions
	Symbols and pictograms	1) It is recommended to develop a hospital-specific symbol and pictogram system Integrate these symbols and pictograms with text where necessary, allowing symbols or pictograms to take precedence over text when needed 2) Enhancing the Use of Universal Symbols and Pictograms. Symbols or pictograms should be at least 76.20 to 203.2 mm in height to be legible [18]
	Colors	1) Ensure consistency in color usage and tone uniformity throughout the signage system 2) Suggest using high-contrast color combinations to differentiate between primary and secondary information, such as red-white and blue-white 3) Recommend using variations in color to delineate different medical functional areas
	Placement, dimensions, and typology	1) Placement should be determined based on pedestrian flow, viewing angles, and primary walking paths, such as main routes and turning points. Avoid placing signage directly in front of or behind intersections 2) Signage should be placed at a height that is easily visible and accessible to a wide range of individuals, including those with disabilities. In accordance with Americans with Disabilities Act guidelines, the recommended height for signage should be between 48 in. (122 cm) and 60 in. (152 cm) above the finished floor level 3) Signage types at the same hierarchy level should remain consistent, including font, size, text formatting, color, material, appearance, and installation method

(*continued*)

Table 8. (*continued*)

Type	Categories	Design Suggestions
	Illumination, visibility, and legibility	1) Ensure sufficient indoor and outdoor lighting, especially in the vicinity of signage. Avoid glare and shadows to reduce visual distractions. Consider utilizing natural light or soft lighting to reduce glare and reflections, thereby enhancing visual comfort 2) Ensure signage avoids the use of materials that are reflective or prone to glare, maintaining a smooth and non-reflective surface
	Standardization	1) Americans with Disabilities Act, ADA 2) International Organization for Standardization, ISO 3) Human Factors Engineering
Germane Cognitive Load (GCL)	Inclusivity and user characteristics	1) Americans with Disabilities Act, ADA 2) Use raised characters, symbols, or Braille with a size ranging from 13 to 25 mm and spacing between 7.6 to 203.2 mm, utilizing a sans-serif typeface [18]

In addition to the observations of signage usage, it was noted that seniors often encountered issues such as queuing in the wrong lines and taking incorrect routes. To enhance wayfinding efficiency, it is recommended to plan the overall layout of the hospital thoughtfully, ensuring smooth spatial connections between different departments and functional areas. Avoiding congested and complex environments, reducing branching corridors and rooms can simplify the wayfinding process for seniors.

6 Conclusions

In this study, we conducted an in-depth analysis of the design and effectiveness of the medical signage system, found the factors that affect the cognitive load of the senior, and put forward design recommendations to reduce the cognitive load of the senior. It provides a reference for the design of the medical space signage system for the senior and provides reference and exploration for the cognitive load theory in design practice. However, there are still many unexplored aspects in this field. First, more extensive user experiments should be conducted in future research to verify the actual effect of our recommendations on the senior. Second, due to the continuous updating and technological development of the medical signage system, explore how technology-driven innovation affects the design and user experience of the signage system. In addition, it is

planned to gain an in-depth understanding of the use experience of the signage system by hospital staff in order to create more comprehensive design guidelines. Finally, we will continue to pay attention to the standardization of medical signage system design internationally to ensure that our research results are instructive to the wider medical signage system design community. These future research directions will further promote the development of medical signage systems to better meet the needs of the senior and other users.

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