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Discussion on Smart Strategies for Barrier-Free Design of Outdoor Spaces in Healthcare and Wellness Buildings in Chongqing

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Abstract: With the gradual deepening of aging, the barrier-free design of outdoor spaces in healthcare and wellness buildings is crucial to the quality of life for the elderly in their later years. The mountainous terrain of Chongqing poses higher requirements for barrier-free design. This paper analyzes the barrier-free needs of the elderly, systematically reviews the current status of barrier-free design in Chongqing's healthcare and wellness buildings, and proposes targeted smart strategy suggestions from four aspects: barrier-free transportation space, activity space, landscape sketches, and place spirit, combining regional characteristics. These suggestions aim to improve and enhance the quality of the elderly care environment in Chongqing.

Keywords: Integration of medical and nursing care; Healthcare and wellness buildings; Outdoor spaces; Barrier-free design; Smart strategies

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1. Introduction

According to the seventh population census conducted by the National Bureau of Statistics in 2021, China's population aged 60 and above accounts for 18.7% of the total population, with those aged 65 and above accounting for 13.5%. In Chongqing, these percentages are 21.87% and 17.08%, respectively, indicating a higher degree of aging than the national average. In the face of this aging situation, Chongqing is committed to building an integrated elderly care service system that coordinates home, community, and institutional care, and combines medical and healthcare services. This aims to enhance the sense of gain, happiness, and security for the elderly.

The integration of medical and nursing care refers to the combination of medical and health services with elderly care services. It targets elderly people who live at home, in the community, or institutions, and provides them with the necessary medical and health services based on daily care [1]. Medical-nursing integrated healthcare buildings are comprehensive elderly care facilities that combine medical and nursing care services.

They provide integrated living, cultural entertainment, rehabilitation training, and medical care services for the elderly.

Market research statistics show that if the conditions of healthcare facilities are well-established, more than half of the respondents are willing to accept institutional care, and another third do not rule out the option of institutional care. Furthermore, the main considerations for choosing healthcare facilities are the level of medical care and environmental facilities. Field research has found that the elderly people living in these institutions are generally aged 70 and above, and a high proportion of them are disabled or semi-disabled. Therefore, barrier-free design in elderly care facilities is a key aspect of their environmental space quality.

2. Barrier-free design

Barriers can be classified into many types, including behavioral, psychological, language, and intellectual barriers. Barrier-free refers to the elimination or reduction of such barriers, and the essence of barrier-free design is to enhance accessibility [2]. With the development of smart technology, barrier-free design is constantly incorporating intelligent elements, such as smart navigation systems and smart barrier-free facilities, further improving the service efficiency of environmental spaces. The barrier-free design of outdoor spaces in medical-nursing integrated healthcare buildings needs to fully consider the physical functions and behavioral abilities of the elderly. This will better meet their physical and mental needs and enable barrier-free use of environmental spaces.

3. Analysis of barrier-free needs for the elderly

With increasing age, the physiological functions of the elderly gradually decline. Their mobility, memory, and sensory perceptions such as vision, hearing, smell, and touch also deteriorate. Additionally, the flexibility of their hands and feet, as well as reaction speed, decreases. Simultaneously, the elderly are more prone to feelings of loneliness and loss, resulting in higher social and emotional needs. The famous American psychologist Abraham Maslow categorized human needs into five levels, from basic to advanced: physiological needs, safety needs, social needs, esteem needs, and self-actualization needs. Therefore, barrier-free design in outdoor spaces for the elderly should address their physical and mental characteristics to meet these needs.

3.1. Physiological barrier-free needs

The physiological barrier-free needs of the elderly arise mainly from the gradual aging of their bodily organs. For instance, as vision declines, the ability to distinguish objects diminishes. Hence, objects in the space should have high saturation, contrast, and recognizability. Reduced mobility requires simple and clear pathways, with ramps or stairs provided for elevated areas. Due to decreased sleep quality, a quiet spatial environment is essential. Moreover, considering memory decline, easily recognizable signs or symbols are necessary for navigation and recall.

3.2. Safety barrier-free needs

The elderly are more prone to safety hazards due to declining physical abilities. Thus, the spatial environment must address these safety concerns. For example, to prevent falls, furniture, structures, and fixtures should be arranged reasonably, avoiding sharp corners or protrusions. Anti-slip flooring and grab bars should be installed. Additionally, emergency rescue call facilities are crucial to provide timely assistance in case of health emergencies.

3.3. Social barrier-free needs

Retired elderly, especially those in institutional care, are more susceptible to loneliness due to a smaller social circle and separation from family. They require more social activities to enrich their lives. Therefore, the environment should provide ample social interaction spaces, such as entertainment areas, fitness zones, communication plazas, and horticultural experience areas. Alternatively, mixed communities can be established, where people of different ages reside, adding vitality to the elderly's lives.

3.4. Esteem barrier-free needs

As the elderly's self-care abilities decline, their inner need for esteem grows stronger. They hope to have their past achievements and experiences recognized and respected. They desire to maintain autonomy in life choices and decisions, and they yearn to be understood and heard. In outdoor space design, functional activity spaces or detailed designs should cater to these needs. For instance, providing quiet zones for meditation or solitude, and setting up spaces for lectures or performances to fulfill their exhibition needs. Additionally, accommodating the needs of wheelchair users by ensuring that road widths, ramps, and grab bars meet accessibility standards.

3.5. Self-actualization barrier-free needs

The self-actualization needs of the elderly represent the highest level of their spiritual demands. These include personal growth, realizing their own value, and gaining recognition. The environmental space should be designed accordingly, offering various learning opportunities and corresponding outdoor learning areas. For example, organizing literary study classes like those at Tianjin University for the Elderly, where they can gather, share their passions, and even publish their creative works. Moreover, interactive spaces such as gardens or vegetable patches can be established, allowing the elderly to contribute, experience the joy of labor, reap the harvest, and feel the happiness of achieving their value.

4. Analysis of the current status of barrier-free design in outdoor spaces of healthcare buildings in Chongqing

Barrier-free design originated in the 1930s, aiming to eliminate physical barriers in the built environment and enable equal and free access to various facilities and services for all [3]. This design philosophy emphasizes a people-oriented approach, particularly considering the special needs of the elderly. Technical measures in outdoor spaces help older adults better engage with the landscape. Visits to integrated medical and nursing care facilities in Chongqing revealed that while there are corresponding barrier-free design measures, such as step-free design, double-layer handrails, spacious passageways, barrier-free walkways, and emergency call devices, the application of smart technology in this domain is still in its infancy, leaving significant room for improvement as barrier-free design evolves from the material to the spiritual level.

4.1. Material level

Firstly, hardware facilities are inadequate. Many elderly care facilities are renovated from old buildings not specifically designed for the physiological characteristics of the elderly, resulting in limited aging-friendly features in terms of spatial layout, scale, and environmental amenities. Secondly, outdoor spaces are cramped, restricting movement. For instance, the rehabilitation garden at Chongqing Longhu Senior Apartments is located on the rooftop, limiting accessible space, and vertical transportation is required for elders to reach it, reducing convenience and spatial experience. Furthermore, the spatial layout is simplistic, offering outdoor activities with limited functionality and aesthetic appeal, often featuring only hard paving without necessary

supporting facilities, leading to inefficient outdoor space utilization. In addition, the signage system is basic, relying primarily on traditional methods that are not clear or aging-friendly.

4.2. Spiritual level

Most facilities focus primarily on material care, such as daily living assistance and medical nursing, meeting basic needs while neglecting spiritual aspects. For example, landscape designs are often monotone, featuring simplistic planting and lacking cultural depth or humanistic care. Outdoor spaces for entertainment or collective activities are either limited or non-existent, reducing opportunities for relaxation, socialization, and enjoyment, thereby diminishing the outdoor environmental experience.

4.3. Smart technology application level

Chongqing has initially established the "Yu Yue - Elderly Care" smart platform, integrating functions such as welfare home management, smart management of elderly care institutions, and community services. A total of 1,308 elderly care institutions have been connected to video monitoring terminals. Some institutions have introduced smart devices like millimeter-wave radar digital healthcare solutions to monitor elders' health status and activity trajectories in real-time, enhancing safety and convenience. Additionally, a 24/7 smart security system reduces accidental risks. While smart technology applications indoors, such as health monitoring, emergency calls, smart positioning, and intelligent access control, have proven effective, their outdoor implementation remains inadequate.

5. Smart strategy suggestions for barrier-free design in outdoor spaces of integrated medical and nursing care buildings in Chongqing

Outdoor spaces are an extension of indoor living, encompassing environmental elements like transportation spaces, activity areas, and amenities. Designing outdoor spaces for healthcare buildings is a comprehensive systems engineering task that should embody healthcare concepts while emphasizing ecology, functionality, culture, and humanity. The integration of smart technology can significantly enhance the experiential aspect of barrier-free design, creating a more convenient, comfortable, safe, and easily identifiable environment for the elderly.

5.1. Smart design of barrier-free transportation spaces

The organization of traffic flow in outdoor spaces of healthcare facilities should align with the physical and mental characteristics and needs of the elderly. Barrier-free access points, ramps, pathways, and other transportation spaces should be established, and smart technology should be employed to enhance the convenience, safety, and user-friendliness of these facilities.

(1) Barrier-free entrance and exit design

Given Chongqing's unique mountainous terrain, there often exist height differences between indoor and outdoor spaces. In design, step-free entrances and exits, such as level access or equipped with smart ramps and automatic lifting platforms, can connect indoor and outdoor spaces. Smart sensor doors can facilitate access for wheelchair users or elders with mobility issues. Smart signage facilities, including voice guidance, touch screens, and Braille, can be installed to cater to diverse needs and aid elders in navigating spaces efficiently.

(2) Barrier-free ramp design

Ramps are common transportation spaces in Chongqing. In outdoor spaces of healthcare facilities,

ramps are often used to accommodate site height differences, better suiting the behavioral characteristics of the elderly. Ramps for wheelchair access should be designed in straight, segmented, L-shaped, or U-shaped configurations, avoiding curved designs. Ramp widths should accommodate wheelchairs or walking aids, typically being at least 1.2 meters wide, with a slope not exceeding 1:12. However, a 1:16 or 1:20 slope is ideal for safety and comfort [4]. Double-layer handrails can be installed on both sides to accommodate varying height requirements. Additionally, smart technologies like health monitoring and emergency call systems can be integrated to ensure timely assistance for elders.

(3) Barrier-free road design

According to accessibility standards, the minimum width of pedestrian roads should be no less than 1.2 meters to ensure smooth passage for wheelchair users. The ground pavement should have multiple characteristics such as slip resistance, stability, wear resistance, environmental friendliness, and aesthetics to avoid falls due to debris when elderly people are walking. At the same time, the deep integration of smart technology and humanized design will build a continuous, convenient, and safe transportation space system, connecting major functional areas such as medical care, rehabilitation, and elderly care. Adequate rest areas and smart auxiliary facilities will be provided, optimizing traffic flow and reducing cross-interference. The barrier-free road space can introduce a smart lighting system that automatically adjusts brightness based on ambient light, while being equipped with smart navigation and voice prompts to provide real-time guidance for the elderly. Additionally, the Internet of Things technology can be utilized to implement real-time monitoring and maintenance of road facilities, and emergency call systems can be installed to ensure a safe, comfortable, and barrier-free environment for the elderly.

5.2. Smart design for barrier-free activity spaces

Based on the diversity of travel needs and motivations, the types of activities that elderly people participate in also show diverse characteristics [5]. Elderly people of different ages, hobbies, and behavioral characteristics have varying ways of using space. Therefore, a scientific subdivision of the site can be adopted to construct small, functionally diversified venues, enhancing the participation and activity level of the elderly.

(1) Rest and socializing venues

According to research in environmental psychology, the optimal distance range for interpersonal communication is 1–3 meters, with 0.5 meters being a very close communication distance and 0.5–0.7 meters being a relatively close contact distance. Therefore, to meet the social and entertainment needs of the elderly, the design of rest and socializing spaces should be set at an optimal distance to promote social interaction and emotional exchange among them. For example, tall trees can be used to create a stable forest space, complemented by rich plant layers such as shrubs and flowers to form a natural and ecological environment. Spaces such as healing gardens, leisure plazas, meditation spaces, and therapeutic spaces can be provided to meet the diverse needs of the elderly. At the same time, the rest area can be equipped with smart seating, sunshade facilities, smart health detection equipment, emergency call systems, and fall alarm devices to enhance the sense of security and spatial experience for the elderly.

(2) Fitness activity venues

Fitness activity venues include fitness equipment areas, fitness trails, and ball sports venues. The site design should adhere to ecological principles, increase green coverage, and create a natural and comfortable environment. The site layout follows barrier-free design principles, ensuring that there

are no steps within the site, the slopes are gentle, and double-layer handrails are provided for easy and barrier-free use by the elderly. Combining smart technology, smart fitness equipment can be installed in the venue, which has functions such as heart rate monitoring and exercise data recording, helping the elderly better manage their health. Additionally, the venue can be equipped with landscape features and cultural display facilities with regional cultural characteristics, promoting sports culture or health and wellness knowledge, and enhancing the cultural identity of the elderly.

5.3. Smart design of barrier-free landscape features

Landscape features are indispensable elements of outdoor spaces, often serving as the finishing touch in landscape design and playing a pivotal role in outdoor spaces. As details of the environmental space, landscape features are the material carriers of the cultural heritage and spiritual civilization of the region, and an important way to showcase the regional character and unique charm. A successful landscape feature represents a microcosm of regional civilization construction, reflects the style and landscape characteristics of the region, enhances the inherent attractiveness and creativity of the region, and is a product that condenses regional culture. It includes structural features, sculptural features, natural scenery features, and public facility features.

Combining smart technology with barrier-free concepts in the design of landscape features can enhance the interactivity and fun of the space. Modern design techniques such as material innovation, technology integration, and lighting effects can be utilized in the design of landscape features, adding a sense of modernity and technology to them. Digital technologies such as AR (Augmented Reality) and interactive projections can be used to make the landscape features dynamically interactive [6]. The integration of technology and art, applying smart sensing technology and multimedia interactive smart features, creates landscape facilities that can interact with the elderly in real-time. These not only have decorative properties but also interact with the elderly through various means such as light, sound, and touch.

In outdoor spaces, smart seating that can automatically adjust temperature and height can be installed; sculptures equipped with smart monitoring screens can not only meet aesthetic needs but also monitor information such as air quality, humidity, and light in the area, allowing staff to better ensure environmental quality; smart pavilions or corridors can be arranged, utilizing energy conversions such as solar and wind power for smart switching, providing a comfortable environment in both winter and summer; smart medicine boxes that emit voice prompts can be placed in the space to remind the elderly to take medication on time; other small facilities such as sensor-activated trash cans, light and shadow interaction devices, and touch or sound-sensing devices can also be installed.

5.4. Smart expression of the spirit of barrier-free spatial places

In “The Spirit of Place: Towards a Phenomenology of Architecture”, Norberg-Schulz states, “The spirit of place is the fusion of the subjective consciousness space within a person’s heart and the objectively existing space. It refers to a sense of place atmosphere that people experience during their participation in activities, and a sense of belonging or identity that emerges from the place.” [7]. In the design of outdoor spaces for healthcare buildings, landscape storytelling can be employed to connect invisible perceptions such as time, events, experiences, and memories with specific sites. This links people’s experiences in the landscape into various interesting stories, extending their memories of living places [8]. The design method of landscape storytelling is conducive to expressing the spirit of place, exploring the collision between the real environment and traditional or regional culture, enhancing the recognizability of space, and shaping an emotional home with a sense of familiarity, warmth, protection, and belonging. This tightly connects the site culture with the emotional needs of

the elderly.

Firstly, it is the expression of the landscape theme. The theme of a landscape space represents its core spirit and connotation. A specific theme can bring a certain cohesion to the landscape space. Thematic conception based on the history and cultural memories of the site can evoke perceptual resonance among the elderly. For example, in the outdoor space design of healthcare facilities, incorporating elements of local farming culture in Chongqing and setting up landscape nodes themed around farming tools can not only beautify the environment but also evoke memories of farming life among the elderly [9]. Secondly, natural or artificial elements such as terrain, plants, water bodies, small features, structures, and pavement can be selected to create a scenically integrated landscape space effect. Thirdly, smart technology can be integrated to facilitate the expression of the spirit of place. For instance, AR technology can be utilized to enhance the cultural display function of the site, allowing the elderly to immerse themselves in nostalgic scenes through virtual mapped landscapes, thereby enhancing their sense of participation and belonging.

6. Conclusion

In the digital era, the barrier-free design of outdoor spaces for healthcare buildings in Chongqing faces new opportunities and challenges. Smart technology can meet the potential needs of the elderly in terms of information access, facility usage, personalized demands, virtual experiences, data analysis, and facility management. Through smart navigation systems, voice interaction technology, personalized design solutions, augmented reality and virtual simulation technology, as well as data-driven decision support and intelligent management, the convenience and safety of barrier-free facilities can be enhanced. Additionally, it provides a scientific basis for design and management. In the future, with the continuous development and application of digital technology, the barrier-free design of outdoor spaces for healthcare buildings in Chongqing will become more intelligent, user-friendly, and convenient.

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