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Color Design for Public Space Environments in Healthcare Facilities

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Abstract

I investigated the relationship between social support, environmental factors, and color design within the public spaces of healthcare facilities. Through a comprehensive literature review and case studies from major hospitals in the United States, the United Kingdom, and Scotland, I explored how these elements contribute to public spaces' overall concept and function. The study emphasizes the need to establish a clear relationship between the social functions of these spaces and their physical and environmental characteristics. By examining theoretical frameworks and observed examples, I analyzed the impact of color design and the integration of internal and external spaces. The findings highlight that well-designed spaces, especially those utilizing effective color schemes and connecting indoor and outdoor areas, enhance user satisfaction and support healing processes. The results underscore the importance of communal spaces in healthcare facilities for psychological and social healing. I conclude that these spaces should be intentionally designed to foster social interactions among patients and visitors by improving pedestrian accessibility and incorporating social support structures.

Keywords: Color Design, Public Space, Environmental Factors, Healthcare Facility

1. Introduction

1.1 Research background and purpose

Numerous studies have shown that users' emotional responses to color are influenced by various aspects of their physiological and psychological profiles. This study aims to analyze the components of color design and the physical characteristics of public spaces in healthcare facilities to encourage and support user behavior. The study examines the concept of color design approaches based on previous research and analyzes public environmental design elements that enhance the user experience in healthcare facilities. Public areas within healthcare facilities serve as spaces that facilitate the movement of users. These areas support the exchange of experiences and significantly influence overall satisfaction with the healthcare facility. Designing public spaces in healthcare facilities requires the creation of distinctive built environments [1]. This study examines the validity of color design as an environmental factor in creating a healing space in healthcare facilities.

1.2 Scope of Study

This research conducts a review of case studies on the social support, environmental factors, and color design, which constitute the public space of healthcare facilities. This study defines the concept and function of public space in healthcare facilities through a critical literature review and examination of previous studies.

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Furthermore, the correlation between social support, environmental design elements, and the color design of healthcare facilities has been investigated. Next, the connection between the color concept and environmental factors was defined, by reviewing the case studies. Furthermore, the color concept was considered, and environmental factors were investigated by reviewing public spaces in healthcare facilities. This study only considers public spaces that are accessible to the public. Included in the case studies are Phoenix Children's Hospital in Arizona, United States, Queen Elizabeth University & Royal Hospital for Children in Glasgow, UK, and Royal Aberdeen Children's Hospital, located in Scotland.

2. The Healthcare Facility and Social Support

2.1. Designing Social Support within Healthcare Facilities

The term 'social support design' refers to the use of physical environmental factors, such as spatial organization and furniture placement, to facilitate social support and user interaction behaviors. These interactions, particularly in healthcare facilities, assist in reducing stress, aiding in physical recovery, and engaging patients, their families, and the public. Sadler, DuBose, Malone, and Zimring [2] emphasized the importance of designing a physical environment in medical facilities that incorporates social support to enhance the healing effect. Marcus proposed a physical environment designed for social healing, emphasizing a social support approach [3]. Ulrich (4) emphasized the importance of incorporating natural elements into the healing environment and how altering the surrounding atmosphere can affect it. He also highlighted the significant role of utilizing the patient's social support in treatment. Positive distraction through environmental control, social support, and stress-reducing physical and environmental factors are crucial for designing supportive healthcare spaces. Expanding social support in the public domain is crucial for creating healthcare facilities that cater to patients, their families, and medical staff. This would create an appropriate environment where social support can be an essential factor in the patients' recovery. Figure 1 classifies the conditions of treatment facilities in this study.

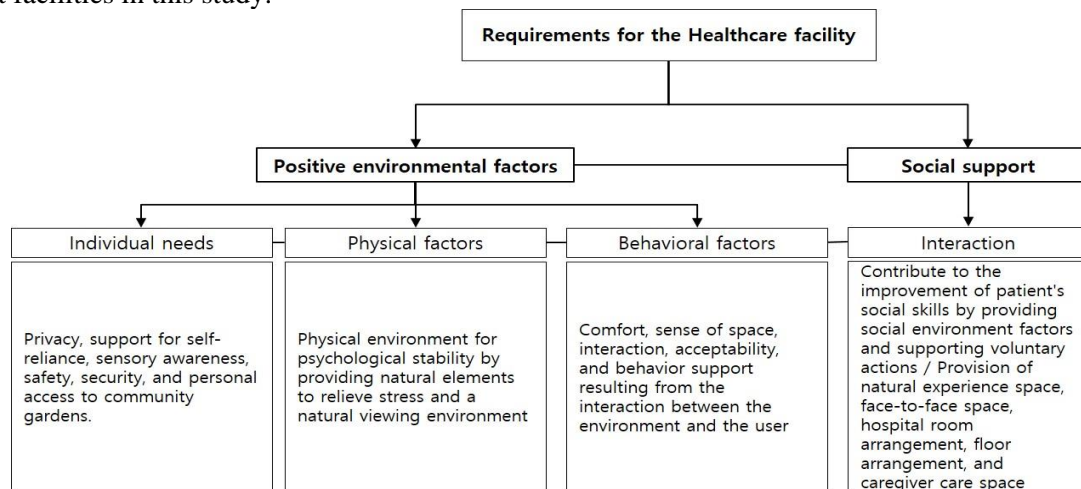


Figure 1. Requirements of a healthcare facility

2.2 User Experience and Public Space in Healthcare Facilities

The public space of healthcare facilities is the area that is most exposed to the public and has functions that allow for access, circulation, and distribution. A hospital street in a healthcare facility may be considered a public space that allows for mixed functions while reducing congestion of access, for example, by separating spatial areas based on function [5]. Ko and Lee highlighted the concept of public space in healthcare facilities as a key factor to consider in hospital construction in their study [6]. Ulrich demonstrated that providing natural scenery to outpatients after surgery could result in fewer days spent in the hospital and reduced pain levels [7]. Designing public spaces in healthcare facilities is considered crucial for promoting positive environmental factors and social support, as per the requirements [8]. The design of public spaces should prioritize the patient

experience by facilitating easy navigation throughout the facility. To reduce stress and provide comfort during waiting times, it is necessary to strategically place the air conditioning system, and use comfortable chairs, soothing colors, and artwork. Reducing user waiting times can be achieved by providing self-check-in kiosks and computers with guidance. Additionally, environmental factors such as light influx, access to outdoor spaces, a warm color scheme throughout the reception area, personalization of space as a work of art, and a visual approach through suitable textures and materials, particularly in inpatient facilities, should be considered. Figure 2 classifies the environmental elements in healthcare facilities.

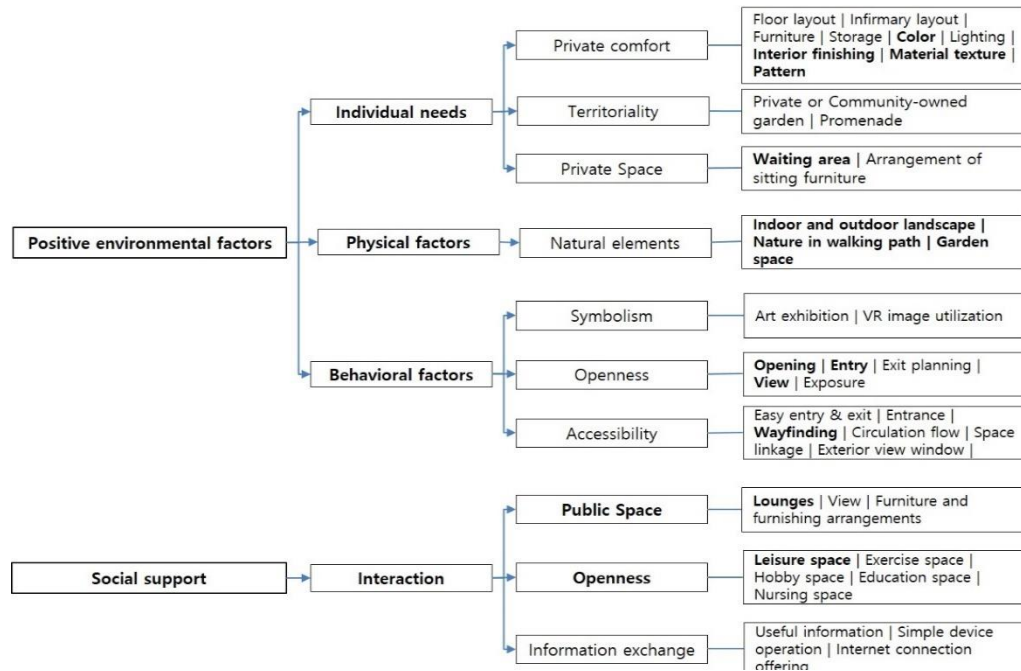


Figure 2. Environmental elements in healthcare facilities

3. Evidence-Based Design for Healthcare Facility

3.1 Color Design in Healing Environments

Colors are considered crucial therapeutic tools that directly contribute to the healing process [9]. According to psychiatrists and psychologists, colors can direct an individual's attention outward and divert their mental focus, thereby alleviating internal stress [10]. The physiological reactions to colors are still being investigated, and some studies suggest that color may have more scientific significance than just being aesthetic. Research has shown that warm colors, such as red, orange, and earth tones, have longer wavelengths that can stimulate the nervous system. In contrast, cool colors such as blue and green can have a calming effect on the nervous system due to their shorter wavelengths. Faber Birren's research has established a connection between color and physiological responses. The study demonstrated that exposure to red stimulates the pituitary gland to signal the adrenal gland, releasing adrenaline. Exposure to blue leads to the secretion of hormonal neurotransmitters in the brain that have sedative effects [11]. Kurt Goldstein demonstrated that the human autonomic nervous system is universally stimulated regarding color perception [12]. Schuschke and Christiansen conducted a study on sixty-eight patients, and the subjects reported a preference for bright colors for all objects, including curtains, furniture, and linen, on the ceiling, wall, and floor [13]. The medical facility environment is increasingly recognizing the importance of design effects that unconsciously consider the physiological and psychological effects of colors. Roger Ulrich investigated the effects of visual stimulation on patients' recovery rates and found that patients in a lively environment required less pain medication and recovered three-quarters of a day faster than those in non-live environments. Other studies have shown that

stress levels can be significantly reduced when exposed to nature, whether real or simulated [14]. Studies in visual science and clinical research indicate that the brightness and contrast of colors are the most consistent focus. These studies are inadequate to provide evidence of a direct association between specific colors and behavioral or health outcomes. However, they are useful in manipulating perceptual impressions, such as spatial sensation.

3.2. Guidelines on Color for Healthcare Environments

According to Tofle et al. (2004)'s study, colors can have positive or negative effects on healthcare and can help reduce the institutional look of healthcare environments [15]. It is important to consider the context of the environment when implementing the use of colors and to note that extended confinement may lead to elevated levels of anxiety and monotony among patients. The hypothesis that color vision alters an individual's sense of time is widely acknowledged. They suggest using colors that are more suitable for the changing color vision of the elderly and high-contrast colors can aid in identifying volume, shape, edge changes, and planes. Vibrant colors are preferred for locations that require physical activity. Also, conflicting opinions suggest that intense colors should only be used for accents and contrasts, as saturated colors may result in unpleasant psychological associations. For individuals with epilepsy and neurological diseases, it is recommended to avoid red as it has been shown to increase blood pressure based on research suggests that certain colors can have an impact on health. It is recommended to use recommendations rather than a hierarchy of principles to govern color specifications. Some researchers suggest avoiding yellow, purple/violet, and yellow-green colors due to their impact on skin tone. While white walls provide a bright and clean aesthetic, using only white may result in a space that appears empty and lifeless. Furthermore, prolonged exposure to dark colors can have a clinical and psychological impact on some individuals. Conflicts may arise in medical settings when color specifications for the same functional area clash. These conflicts can be caused by a range of factors, such as skin tone, sense of time, disease or disorder type, afterimages, monotony, noise, room size and function, and the user's age and gender. Mahnke argues that empirical evidence is not always necessary to support design guidelines and presents the color and lighting design objectives established for healthcare facilities in Table 1 [16].

Table 1. General color design guidelines

1	Color specifications utilized in healthcare facilities should be selected based on psychological and aesthetic aspects.
2	Color specifications used in healthcare facilities should aim to protect the physiological and psychological well-being of patients while promoting the healing process.
3	Color specifications utilized in healthcare facilities should aid in precise visual medical diagnosis, surgical performance, treatment, and rehabilitation services.
4	Color specifications in healthcare facilities support improvements in illumination, visual ergonomics, orientation, the distribution of information, visibility of specific areas, and refinement of working conditions through visual means.
5	When selecting lighting for healthcare facilities, it is important to consider functionality, psychological impact, visual appeal, color expression, and biological factors.

Color psychology can enhance the function of a space or room by applying distinct colors. In healthcare environments, color plays a significant role, from well-lit outdoor areas to more subdued operating rooms. Natural colors, such as green, blue, or brown, are considered calming. Table 2 shows that a deliberate choice of colors can improve user comfort [17].

Table 2. The general color scheme in the healthcare facility

Patient rooms	Make patients feel at home	According to a study, patients prefer lighter hues for their rooms and neutral palettes with soft natural tones work best for calming patients and their family members faced with the stress of having an ill loved one.
Employee spaces	Increase comfort for doctors and nurses	Healthcare workers need places of respite to rest and recharge. Brightly lit rooms with stronger color palettes are preferred by many workers.
Operating rooms	Neutralize the reds	In the operating room, surgeons and surgical nurses are focused on one color: blood red. Blue or green walls contrast against the

		red and avoid stark white backgrounds.
Accommodations	Consider patient conditions and age	Children's hospitals are often colorful and bright, while nursing homes are softer and more neutral. Saturated colors are better for elderly patients with poorer eyesight.

3.3. Color Recommendations for Public Areas in Healthcare Facilities

Color planning in the hospital's public spaces - including the lobby, waiting rooms, corridors, patient rooms, and cafeteria - can enhance the hospital atmosphere, improve visual clarity, support the healing process for patients, create a conducive environment for caregivers and improve the work environment for staff. As short-stay areas, these spaces offer greater freedom of color choice and more potential for visual activity than other public and clinical areas. The lobby and waiting room are the primary areas that introduce patients and their families to the hospital environment. This area promotes a positive experience and social interaction for users by incorporating comfortable mobile furniture and strategic use of color to direct visitors. Strong accent colors can be used to zone corridors and reception areas to aid in navigation and wayfinding, as well as to identify different departments [18]. As a significant public space within the hospital, hallways should be designed with warm, visually comforting colors. The color scheme used in hallways should be considered when selecting colors for other sections of the hospital. To enhance the visual appeal of long hallways, color blocks can be used to divide them, making navigation easier and adding a pop of color. The hallways of surgical and intensive care units typically feature calming colors to create a peaceful environment. Bold accent colors may also be

used to mark corridors and receptions for navigation and to differentiate between departments [19]. The reception and waiting room are crucial spaces that introduce patients and their families to the hospital surroundings. To establish a tranquil ambience with visual appeal, a color scheme incorporating diverse accents and artwork is crucial in the waiting area. These confined spaces permit greater latitude in color selection and present a higher potential for visual stimulation than other public and clinical areas. To enhance positive experiences and encourage social interaction, mobile furniture is placed for comfort, and color shades help manage visitors. Table 3 displays the recommended colors for public areas in healthcare facilities.

Table 3. Recommendation of colors for public areas in healthcare facilities

Public Area	Color Recommendation
Waiting area	Color accents and artwork for visual appeal. Accent color and visually appealing color combination.
Hallway	Bright colors are the order of the day in the hospital's children's corridors. Color blocks can be used to divide the space in long hallways. The end of the hallway provides a visual cue with colors.
Cafeteria, Dining	Develop a calming color scheme for the major medical facilities already in place
Nurse stations	A bright and welcoming color palette has been chosen. The color and design choices aim to foster emotional connections with the medical staff.

4. Case Studies of Public Space in Healthcare Facilities

4.1 Phoenix Children's Hospital

The Phoenix Children's Hospital is an excellent illustration of how the use of color can have a calming effect on both children and parents, while also promoting wellness and resource conservation for all who are present. The Phoenix Children's Hospital is a building with eco-friendly design features, including a purple LED-lit facade that evokes the night-blooming cactus flower of the Arizona desert. The three-story lobby provides an engaging experience, with a lighted floor and a stunning 'water' wall that creates the illusion of falling water through a combination of textured surfaces and flowing, dappled lights. The colorful lobby design adds warmth and personality to the hospital, making it less clinical, while the tower streamlines the facility, creating a unique local landmark with stunning views of the surrounding mountains and valley. The building was oriented on an east-west axis for more efficient circulation and daylight harvesting, while exterior shades and high-performance glazing make the most of sunlight while reducing glare. A rooftop garden of over 5,000 sq.ft.

completes the integration of environmental and human design, providing a beautiful space for parents, patients, and staff to relax alike [18].

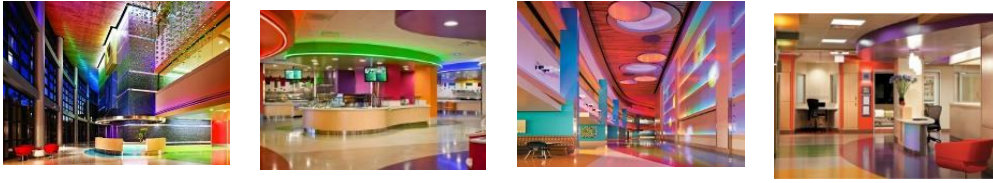


Figure 3. Phoenix Children's Hospital

4.2. Queen Elizabeth University & Royal Hospital for Children

The Queen Elizabeth University and Royal Hospital have made significant strides in healthcare design and delivery. Additionally, they have positively impacted the community and enhanced the healing experience for patients, caregivers, and the wider community [20]. Covering an area of 170,000m², the Queen Elizabeth University and Royal Hospital, designed by IBI Group, consolidate services previously offered at four separate hospitals across Glasgow. This single complex includes an acute hospital with 1,109 beds, a children's hospital with 259 beds, laboratories, and support facilities. It is nestled within three hectares of parkland. The building's unique functions are expressed through three distinct geometric forms that draw inspiration from Clydeside's maritime heritage. They are Vessel - the children's hospital, Dock - the adult hospital podium, and Beacon - the 100% single-bed adult ward tower. Inside the building, there are top-lit atria which consist of brightly colored cantilevered pods. This dispels the conventional perception of a clinical environment. This non-institutional approach is reinforced outdoors through the presence of a large park that surrounds the main entrance. Also, near to this park, there is a children's park that creates a sense of unconfined care. The standardized nursing unit layout reduces travel distances and optimizes patient observation. Additionally, it allows the capacity of adjacent units to be adjusted based on patient demand. The design has significantly increased patient throughput and helped reduce infection rates by offering 100% single occupancy adult bedrooms and almost 100% single occupancy children's bedrooms.

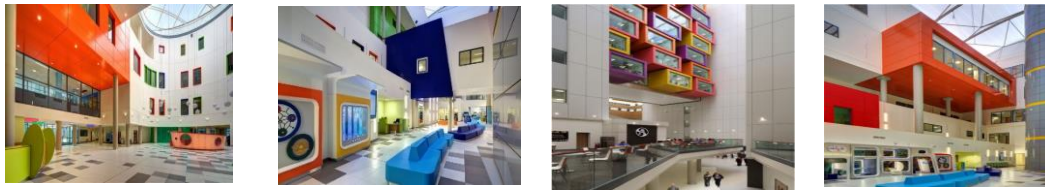


Figure 4. Queen Elizabeth University & Royal Hospital for Children

4.3. Royal Aberdeen Children's Hospital

Tinto Architecture collaborated with The ARCHIE Foundation to determine the floor colors and the overall design. They applied their understanding of color psychology, informed by extensive research conducted by Swiss psychiatrist Carl Gustav Jung. Tinto Architecture was tasked with creating an innovative design for the reception and café area at the front entrance of the hospital. They aimed to make the existing reception area more child-friendly by producing surroundings that promote a calm and comfortable environment for patients and parents. The hospital area boasts a large tree structure in the center of the main waiting area, accompanied by large windows that extend from floor to ceiling, providing views out onto the gardens. Green tones were selected to link with the new hospital garden and reflect its calming nature, thereby promoting reassurance, harmony, and balance. For the interior environment to have a positive impact on patients and staff, Forbo Flooring Systems' acoustic floor covering with 15dB impact sound reduction and easy maintenance was specified. In the center of the room, Forbo's Sarlon in Avocado and Lime colorways was specified with a striking blue border. For the family waiting area, Forbo's Eternal Wood in Elegant Oak was used as its natural design complements the outdoor theme of the room. In the fundraising office, Buttercup Yellow is used to evoke optimism, confidence, and friendliness, creating a positive impact on hospital visitors [21].



Figure 5. Royal Aberdeen Children’s Hospital

5. Discussion

Firstly, the utilization of aesthetically pleasing colors can result in enhanced outcomes in a multitude of waiting areas, including lobbies, lounges, and social support spaces within healthcare facilities. A color scheme for the waiting spaces is necessary to foster a sense of tranquility through the strategic use of color accents and artwork for visual interest. Secondly, the visual calmness provided by the color of the hallway is of great consequence in determining the color palette for the rest areas in healthcare facilities. A variety of colors may be employed in the design of hallways. The selection of warm and visually soothing colors can enhance the appeal and comfort of a large area. Moreover, the application of color in the hallway serves as a visual indicator, ensuring the continuity and distinction of services on each floor. It is therefore recommended that the endpoint of the hallway should receive emphasis by providing a color-based visual cue to visitors, thus assisting them in identifying their destination. Thirdly, the commercial area, comprising a cafeteria, dining area, and gift shop, serves as a place for relaxation and provides a welcome escape from the medical environment. Therefore, this area should be designed with a color scheme that promotes relaxation, thus creating an ambiance that is entirely different from that of the medical service areas.

Table 4. Research findings for public areas in healthcare facilities

Healthcare Facility	Research Findings Case Study Summary	Key Color Strategies and Design Features
Phoenix Children's Hospital	This hospital utilizes environmentally friendly design strategies, with a focus on color choices that enhance user experience and promote healing. The hospital features a purple, LED-lit façade with eco-structure elements, integrating color into the public areas to promote calmness and wellness.	<ul style="list-style-type: none"> - Color Scheme: Purple façade, calming interior colors. - Design Features: A lighted floor and a wall that creates the illusion of falling water using textured color surfaces and dappled lights. - Outcomes: Improved health and well-being, enhanced wayfinding, and connectivity to nature.
Queen Elizabeth University & Royal Hospital for Children	The hospital adopts a non-institutional color design that integrates innovative design principles, promoting both indoor and outdoor experiences for patients and their families. The public lobby is distinctively designed with brightly colored cantilevered pods and natural light, creating a welcoming environment.	<ul style="list-style-type: none"> - Color Scheme: Bright, non-institutional colors. - Design Features: Brightly colored pods in the lobby, integration of a large park, and natural elements surrounding the hospital. - Outcomes: Enhanced therapeutic benefits, improved spatial experience, and environmental responsibility.
Royal Aberdeen Children's Hospital	The reception area and public spaces are designed with a calming, green-toned color scheme, reflecting a natural motif that links the hospital to its garden. The design aims to enhance the psychological healing of long-term inpatients by creating a harmonious and balanced environment.	<ul style="list-style-type: none"> - Color Scheme: Green tones throughout public spaces. - Design Features: Natural motif design, an entrance path with natural elements leading to an outdoor garden. - Outcomes: Increased psychological healing, especially for long-term patients.

6. Conclusion

This study examines the role of comfortable public spaces in healthcare facilities, emphasizing their importance in enhancing healing services, spatial experiences, and access to information. The key areas, such as lobbies, lounges, hallways, and commercial zones, fulfill user needs, facilitate social interaction, and foster

psychological healing. The use of color in these spaces is significant, particularly in waiting areas, where pleasing colors can improve emotional stability and the facility's image. The colors used in hallways should provide a sense of visual calmness and guide visitors through color cues at key endpoints. A relaxing color scheme in commercial areas, such as cafeterias and gift shops, is essential to create an ambiance distinct from medical spaces. The study acknowledges the challenges of adhering to guide color specifications, which must consider factors like skin tone, illness type, and user demographics. However, it underscores the importance of understanding these factors to enhance patient experiences through thoughtful color design in healthcare settings.

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