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## **DESIGNING A PUBLIC HOSPITAL IN MALAYSIA: A COMPREHENSIVE APPROACH IN ENHANCING HEALTHCARE FROM THE ARCHITECTURAL PERSPECTIVE**

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### **Abstract**

The public healthcare system in Malaysia was established in the 1850s, prior to the country's independence. Today, it encompasses 146 public hospitals to provide affordable and accessible healthcare services to all Malaysian citizens. However, the public healthcare sector faced various challenges, including ageing facilities and infrastructures, deferred maintenance, limited accessibility, and inefficient layouts. This paper presents a comprehensive approach in designing public hospitals in Malaysia, with a focus on addressing the healthcare needs of the population and improving healthcare infrastructures through architectural optics. This article explores key aspects of hospital designs, including architectural considerations, functional requirements, technological integration, and compliance with regulations and relevant acts. Eight expert samples were employed through semi-structured interviews to ensure credibility and validity. This methodology allowed flexibility in questioning and yet tailored exploration of relevant issues and expertise. Clear data sources and research objectives were established to minimize potential bias and limitations. By incorporating patient-centric design principles, enhancing accessibility, promoting sustainability, and considering future scalability, the proposed design aims to improve public hospitals that can effectively meet the healthcare demands of Malaysia. The recommendations outlined in this study can serve as a guideline for policymakers, healthcare authorities, and designers involved in the creation of efficient and effective healthcare facilities.

**Keywords:** Healthcare Facilities, Healthcare Services, Hospital Designs, Public Hospitals

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## **INTRODUCTION**

The public healthcare system in Malaysia commenced when Penang General Hospital and Taiping Hospital were established during the pre-independence era in 1850 and 1880. During the post-independence era in 1958, the Ministry of Health (MOH) was established to spearhead healthcare services in the country and objectively provide and develop a comprehensive public healthcare system in Malaysia. The healthcare system played a pivotal role in ensuring the well-being and prosperity of a nation (Ministry of Health, 2020). In Malaysia, the demand for high-quality healthcare services continues to rise, driven by population growth, increasing life expectancy, and evolving healthcare needs. Some of the challenges faced by public healthcare are overcrowding and long waiting-lists, financial and workforce sustainability, ageing facilities, accessibilities, spatial quality, technological integration, and others.

As a result, there is an urgent need to enhance healthcare infrastructures, particularly through the architecture's optics (Harrouk, 2020), that cater to the diverse healthcare requirements of the population. Due to constraints of financial management, the government and public healthcare authorities should find the perfect equilibrium of building new, extending, renovating, or retrofitting the existing facilities. The design of a public hospital goes beyond the physical structure; it encompasses a holistic approach that considers the needs of patients, healthcare professionals, and the community at large. Creating a healing environment that promotes patient well-being, accessibility, and operational efficiency requires careful planning, integration of advanced technologies, adherence to regulations, and consideration of financial sustainability. These comprehensive approaches aimed to address the evolving healthcare needs and challenges faced by Malaysia's public healthcare system, with a focus on maximizing user impact and improving patient outcomes.

## **LITERATURE REVIEW**

### **The Quality of Hospital Design Impact on User**

In the 21<sup>st</sup> century, new methodologies and increased efforts are being conducted to study various architectural qualities and their impacts on human perception. In keeping with the architect's belief that experiencing and controlling the physical healthcare environment as part of the supportive environment can significantly benefit their end-users, this situation directly boosts patients' physical and mental well-being, patients' reduction in stress, and avoids feelings of helplessness while being treated in the hospitals. Hospitals in today's world will always be associated with innovative healthcare practices that promote well-being (Sal Moslehian, 2023).

Advancements in healthcare, technology and research significantly influenced the design of therapeutic environments. Modern medical practices prioritised patient-centred care and integrate cutting-edge technologies, shaping the layouts and features of healthcare facilities. In the context of healthcare design, the notion of quality treatment originated from the "Plane Tree Theory" paradigm, which was pioneered as a new approach to architectural design as Patient-Centred Design (PCD). The PCD deals with the interaction between the physical environment and the patients' preferences thus improving their recovery and safety during their treatment. Several hospital design studies demonstrated that the quality of the physical environment and treatments offered in a healthcare setting played an important role in meeting the patient's preferences as well as the expectations of their family and friends (Jaafar & Othman, 2016). The impact of a positive physical environment in hospitals is illustrated in Table 1 below.

**Table 1: The Impacts of Positive Physical Environment in Hospital**

<b>Impact of Positive Experience</b>	
<ul style="list-style-type: none"> <li>● Reduced infections at hospitals.</li> <li>● Reduced medical mistakes.</li> <li>● The increased overall quality of healthcare.</li> <li>● Decreased patient and visitor burden.</li> <li>● Reduced depression.</li> <li>● Improved social functioning.</li> <li>● Health rehabilitation.</li> <li>● Strengthening patient safety and confidentiality.</li> <li>● Minimized patient downtime.</li> </ul>	<ul style="list-style-type: none"> <li>● Return to the hospital and a more substantial reputation for the organisation.</li> <li>● A shift in physical &amp; cognitive operation.</li> <li>● Strengthened social contact and social support.</li> <li>● Reduced use of pain medicines and negative emotions.</li> <li>● Reduced patient worries.</li> <li>● Health promotes behaviour &amp; therapeutic effects, such as relaxing surroundings.</li> </ul>

*Source: Jaafar & Othman (2016)*

This model enhances the current design requirements for healthcare facility projects in the United States, Canada, Australia, United Kingdom and Netherlands. Angelica Thieriot founded the PCD in 1978 due to her negative experiences with healthcare facilities and the environment (Sahamir et al., 2019). Table 2 below depicts several literature studies and discovered that the physical environment played an essential role in users' satisfaction variables. Some of the elements of the physical environment are indoor comfort, sustainability features, size and placement of openings, and universal design features. These elements may result in improvements in terms of psychological reactions such as mood, communication, interpersonal patterns, or work performances.

**Table 2:** The Physical Environment Affecting Users' Satisfaction

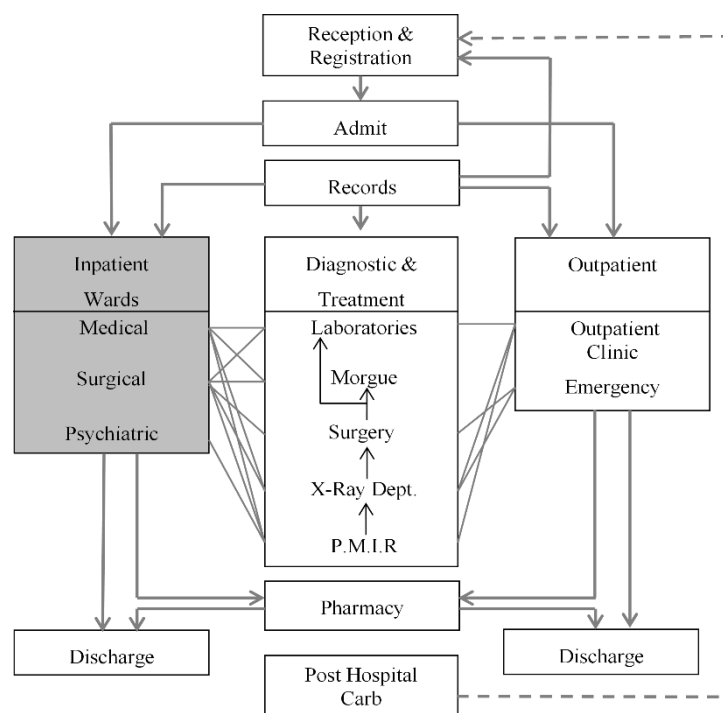
Subject	Physical Environment	Scholars
Indoor Comfort	Indoor comfort through architectural design and appropriate room temperature.	Abu Samah et al. (2012); Schreuder et al. (2016)
Sustainable	Physical well-being, healing environment, collection of material reservations and architectural design.	Gupta & Du, (2013); Rezazadeh & Sarbangholi, (2017).
Size and Scale Functionality	Sizing of the room, the placement of the windows, the amount, and the type of facilities.	Jaafar & Othman, (2016); Christiansen et al. (2016).
Universal Efficiency in Architecture	The criteria for ergonomics, accessibility standards, building codes and requirements for urban planning	Abdellah et al. (2018); Takashi et al. (2013)

Source: authors

### Functional Requirement of Public Hospital and Relationship

The doctors' and patients' engagements in hospitals are influenced by a variety of spatial and configurational factors (Setola et al. 2013). The complexity of the hospital buildings in terms of spatial design requirements ranges from diagnostic and medical care to clinical laboratory, radiology, the emergency department, as well as surgery. Food service and housekeeping are offered as auxiliary services for patients in the ward. Integration with building services and building automation systems is crucial to ensure the efficiency of building operations. The physical relationship between clinical and non-clinical functions determined the configuration of hospital buildings. However, the physical layout and design of the hospital will be dependent on various determinants such as site restrictions, climatic factors, financial support, equipment, and existing technology (Alalouch, 2009).

A good hospital design should incorporate a system of public integration core, a system of staff integration core, public accessibility, vertical and horizontal linkages, and functional spaces (Setola et al. 2013). Integration of these will help to elevate the users' experience in the hospital. A team of consultants such as architects, engineers, planners, designers, and others will play essential roles in this process therefore a high-quality multidisciplinary effort and communication must be established (Mohd Fateh et al., 2023). The design and planning of healthcare buildings require holistic and meticulous processes such as considering the local identity, culture, and customs (Mozaffar et al. 2018). The intricate interrelationship between the clinical and non-clinical functions of a hospital is illustrated in Figure 1.



**Figure 1:** Major Clinical and Non-Clinical Space Relationship Diagram in Hospital  
 Source: Adapted from Alalouch (2009)

### Element of the Physical Environment in Hospital Design

#### *Windows and Openings*

There is a growing consensus acknowledging the pivotal role of windows and openings in creating optimal physiological, emotional, and psychological conditions for both patients and workers in energy-efficient settings. Windows contribute through three essential benefits: harnessing natural sunlight, facilitating natural ventilation, and offering a view. Numerous studies revealed that patients with access to well-designed windows were more likely to recall their admission and departure, maintain focus during their stay, and achieve improved health outcomes, including the prevention of sleep difficulties, hallucinations, and misconceptions. The significance of windows and openings extends beyond their functionality. It should be suitable for three distinct groups of people: patients' comfort, hospital staff's visual needs, and visitors' visual needs as indicated by Gatea et al. (2020). Windows served as vital connections to the outside world for patients, as it contributed to a sense of orientation and aid in maintaining normalcy. Consequently, well-planned windows are not an intuitive element but require meticulous consideration of design, context, and cultural

nuances. In addition to their impact on occupants, windows play a crucial role in enhancing thermal comfort within buildings and influencing green building standards. Rahman (2021) mentioned in a study that the green building rating system, while emphasizing energy efficiency, also considered factors like Indoor Environment Quality (IEQ) to ensure occupants' comfort. Research on improving thermal comfort in wards area through natural ventilation is limited, with conventional energy cogeneration methods proving ineffective in addressing tropical climate-controlled natural ventilation issues in government hospitals. Yau et al. (2011) suggests that while mechanical ventilation systems enhance the interior environment, their higher energy consumption and operational costs make them suboptimal for resolving the issue.

#### *Effective Accessibility and Efficient Furniture Placement in Hospital Design*

The implementation of modern open-plan ward designs brought significant advantages for medical personnel, notably in terms of facilitating easier patient monitoring and supervision as highlighted by Alkali et al. (2018). The open-plan layout was designed to streamline movement, establish a straightforward system of circulation, and enhance overall accessibility, functioning as both a friendly escape route and exit plan. This design not only fostered an improvement in family and social interactions but also contributed to encouraging better behaviour within the open-plan environment, as noted by Han (2014). However, despite these potential benefits of an open plan, there remains a challenge related to the audibility of patients' expressions of dealing with pain within the ward environment. This issue is compounded by space limitations and the bed layout specifications mandated by relevant parties, making it difficult to find a straightforward solution. Nevertheless, it is worth noting that the effective circulation and efficient placement of beds and medical equipment do help to facilitate treatment and streamline duties for both medical staffs' and patients' comfort. Interestingly, aligning the beds parallel to the windows offer additional benefits for patients. This positioning allows them to access outside scenery, providing direct ventilation and natural lighting. The intention behind this arrangement is to enhance the overall treatment experience and medical care for patients, aligning with both their well-being and the practical considerations of medical professionals. In the post-COVID-19 landscape, there is a noticeable increase in the demand for courtyard space (Rong & Bahauddin, 2023). This shift indicated a growing emphasis on outdoor environments within healthcare settings. The evolving priorities emphasised the demand for adaptable and patient-centric spaces in hospital design.

### **Challenges in Hospital Design**

There has been a surge in hospital design studies recently, emphasising the importance of prioritising the well-being of end users. This emphasis is especially critical given the inherent vulnerability and impairment often present in hospital populations (Ghani & Aripin, 2018). As hospital buildings evolve, there is an increasing awareness of the changing demands placed on both their internal and external environments. Recognizing and addressing these challenges throughout the development process is crucial, as emphasised in a study by Nirit and Yehuda (2017), Alkali et al. (2018), and Zainudin et al. (2023). By ensuring the safety of public facilities in hospitals, encompassing both clinical and non-clinical areas had remained paramount. The integration of advanced diagnostics and treatment technologies, along with compliance with the HIPAA Regulations (Health Insurance Accountability and Accountability Law), had addressed certain issues, but there is a growing concern about the potential increase in energy consumption resulting from the dependency on such equipment within hospital buildings.

Furthermore, the design of hospitals, especially regarding the fire safety requirements, differs from other building types. As mentioned by Ab Ghani (2018), natural ventilation through window design is a common form of ventilation control in hospital buildings. However, insufficient design considerations for natural ventilation may lead to inefficient airflow, contributing to the dispersion of undesirable hazardous gases during structural motions and healthcare policies. The Malaysian Standard, similar to the UBBL 1984 (Hanie Suraya, 2015), permits the use of windows as smoke ventilators in case of fire. While the UBBL 1984 focuses on window design criteria for daylighting and ventilation, it does not explicitly address window designs and specifications for smoke ventilation during a fire. Based on Section 39, sub-clause 2, specifically mandates window design criteria for natural lighting and ventilation in hospital wards, without accounting for smoke ventilation during a fire outbreak. A study done by Ashraf & Nambiar (2022) delineates the significance of hospital buildings in any community is undeniable, given their profound impact on human health and the environment. The increasing attention towards constructing health-centric, environmentally friendly, and sustainable hospital infrastructures is noteworthy. Sustainable hospital design signifies the interconnected dimensions of the environment, economy, and society. Sustainable hospital designs aim to reduce energy and resource consumption, mitigating their adverse environmental impact. Understanding the principles of sustainable design is crucial, especially in the context of hospitals, which are characterised by complex energy, air conditioning, and temperature management systems.

## **RESEARCH METHODOLOGY**

Hospital designs in architecture require a multitude of expertise and complexity. This study utilised a survey-based method. Semi-structured interviews were employed to develop questions based on clear definitions and linear frameworks from past studies. These questions were subsequently modified for data collection and generating themes (Miles & Huberman, 1994; Miller & Crabtree, 1999; DeWalt & DeWalt, 2002; Mason, 2002; Maynard & Schaeffer, 2006). Robson (2002) explained that the questions for semi-structured interviews were determined and can be modified, and these questions can be ignored or added during an interview session.

Semi-structured interviews of eight expert panels give a sense of balance between predetermined questions and flexibility in additional areas of interest. All participants have more than 10 years of experience in the built environment industry and healthcare design. Three of the participants are professional architects. Experts sampling allows for more in-depth responses from participants in healthcare design. The participants were selected based on multiple criteria such as working experience in industry and healthcare design, expertise, and academic qualification. Participants are from the health facility design unit, the architects branch of the Public Works Department, the medical planner (Architect), and the Consultants (Architects). The interviewer gathered insights from the project team before they initiated fieldwork and evaluated the project's compliance with environmentally friendly standards. The Ministry of Health (2020), Liyanatul et al. (2016), and Hyväri (2016) are in unison on the requirements for public hospital construction and passive design incorporation to ensure economical use of active energy.

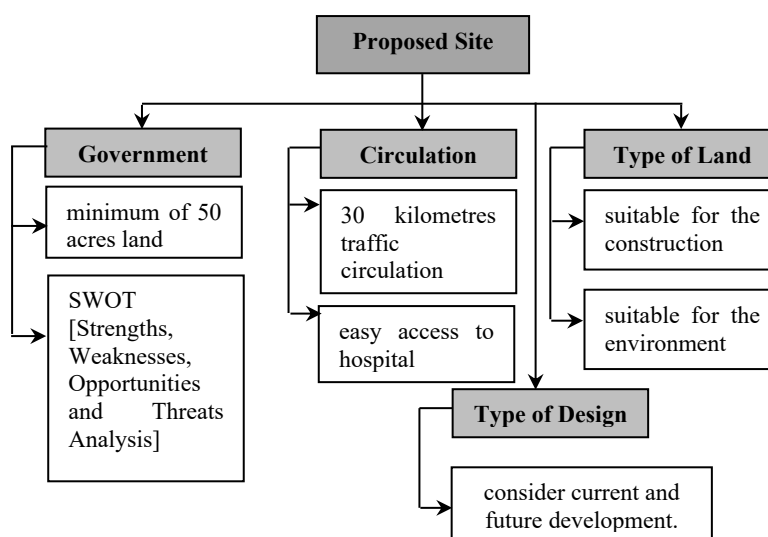
This approach aligned with the government's goal of sustainable construction for public health facilities. The interview process for public hospital design criteria involves the participant's extensive knowledge, from receiving briefs to the building's operational phase. They played a critical role in integrating practical and user-centric considerations into the design of public hospitals. Key aspects encompassed the thoughtful selection of a proposed site and strategic ward design, emphasising user satisfaction and visual comfort. It highlighted the pivotal contribution of the participants in creating healthcare environments that prioritise functionality and the well-being of users. Data sources were cross-checked, and research objectives were clearly articulated to reduce potential bias and limitations.



## ANALYSIS AND DISCUSSION

### Criteria of Selection for the Proposed Site

The first component from this parameter would be the participants expressing a strong preference for a proposed site with a minimum of 50 acres of government-owned land that would be suitable for constructing a hospital. SWOT analysis is beneficial for architects in hospital design as it helps them identify project strengths, weaknesses, opportunities, and threats. It allows architects to leverage strengths, address weaknesses, explore opportunities for innovation, and mitigate potential risks. This tool guides architects in making informed decisions and creating effective hospital designs. Optimum land area will be beneficial especially during inception and planning stages such as ideal building orientation and effective placement of supporting facilities. The development of public hospitals or healthcare structures on such land is seen as advantageous for both macro and micro-scale benefits, particularly in residential areas. It is highlighted that careful planning of traffic circulation within a 30 km radius is essential to ensure convenient access to the facility and accommodate future developments. The establishment of a public hospital is viewed as a positive safety net, enhancing healthcare access, and creating opportunities for new development projects driven by increased demand. The criteria of selection for the proposed site of hospitals are shown in Figure 2 below.



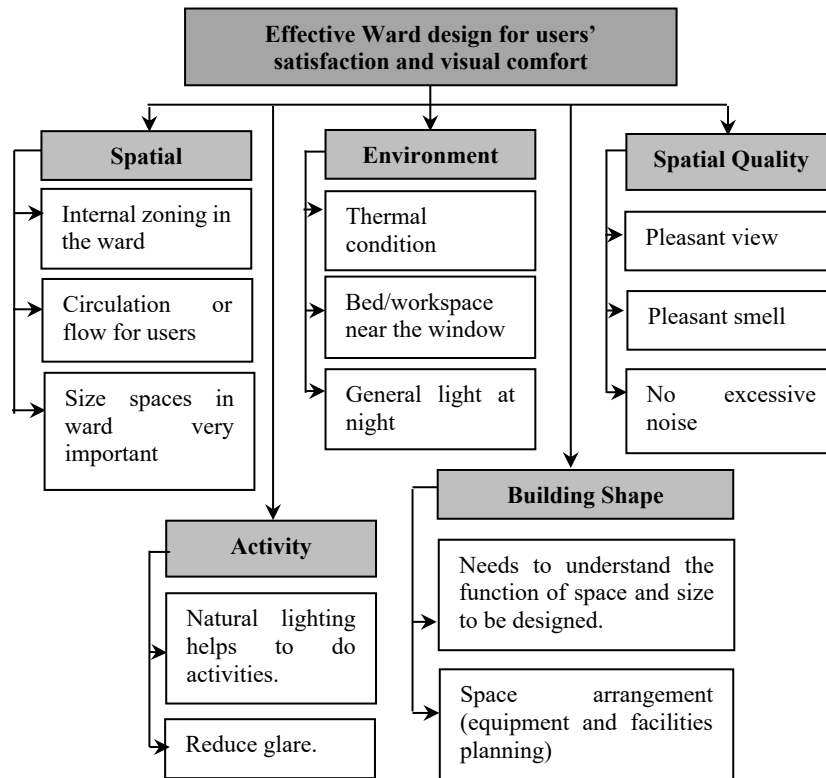
**Figure 2:** Criteria of Selection of the Proposed Site for Hospital Design

Source: authors

### **Effective Ward Design for Users' Satisfaction and Visual Comfort**

The second component of comprehensive hospital design involves spatial planning of effective ward design as it serves as the nucleus of accommodating care and treatment for patients. There are several classifications of wards such as medical wards, surgical wards, Intensive Care Units (ICUs), and other specialised wards. Effective ward design is scientifically proven to accelerate recovery and improve patients' well-being. There are several layers of ward design process. First, the designer will get an MBOR (Medical Brief of Requirement) from the Malaysian Ministry of Health (MOH). The MBOR includes a brief overview and requirements of ward design. Next, the medical planner specialist will create the TBOR (Technical Brief of Requirement) which is more detailed in terms of technical specifications and requirements to facilitate the ward designs and layouts. The design of this ward should be direct, practical, and functional for patients and staff to utilise. The participants signify the importance of effective spatial planning for the current and future development of the hospital. The setting up of a rectangle grid line with a length of 7.5 to 8.4 metres and a width of 24 metres will help to reduce negative space and maximise design efficiency. The 1100 square metres of functional floor space will accommodate a maximum capacity of 28 beds. The form of the building plan is essential since it influences the interior layout of the ward. These elements of effective ward design for users' satisfaction and visual comfort are illustrated in Figure 3.

Effective collaborations and communications between medical planners and medical officers will create a robust TBOR (Technical Brief of Requirement). Patient-Centred Design (PCD) will influence the equipment planning and requirements, power outlet, room dimensions and preferred layout, efficient flow and accessibility, infection and noise control measures and positioning of the bed for patients that will help to improve physical environments in public hospitals. Design coordination is paramount to guarantee that the layout organisation is properly executed. Façade design plays an essential role in natural lighting and ventilation. Common areas for discussion and communication for staff should be established, and auxiliary facilities for visiting family members. Most ward designs employ a central spine for effective ward circulation. In some cases, the wards are located in the centre of the block, necessitating the usage of mechanical systems such as lighting and ventilation, as well as an air conditioning system (HVAC) for user comfort. Relevant legislations and acts, such as the Uniform Building By-Law (UBBL) and the Malaysian Standard, help in standardising the minimum percentage of natural lighting and ventilation factors in hospital design. The related by-laws will regulate the buildings design to protect the life, health, and safety of the individuals.



**Figure 3:** Elements of Ward Design for Users' Satisfaction and Visual Comfort  
*Source: authors*

## CONCLUSION

As demonstrated in this study, strategic location in the inception stage is viewed as a positive measure, enhancing access to healthcare, and opportunities for new development projects. Design coordination in the planning stage will help optimise the ward area in various aspects such as equipment placements, layout preferences, and infection control measures. Incorporation of Patient-Centred Design (PCD) principles and adherence to relevant legislations, standards, and by-laws such as the Uniform Building By-Law (UBBL) and Malaysian Standard is essential. Moving forward, it is recommended to integrate evolving technologies for optimal energy consumption, and adaptive designs to address the changing needs of healthcare. Ongoing research and regular updates in design guidelines will ensure that public hospitals remain at the forefront of providing optimal patient care. This paper has highlighted three significant findings. First,

it emphasises the researcher's role in understanding success criteria through thorough analysis of primary and secondary data. Secondly, combining passive design strategies in hospital projects with effective collaboration among consultants has greatly improved performance criteria. Third, the study's framework has been validated through statistical guidelines and relevant scholarly research.

The unique contribution of this study emphasizes specific frameworks for different stages of hospital design. This approach not only addresses the current and future needs of healthcare facilities but also fosters an environmentally conducive design process. By aligning hospital functions with community and local environments, it stresses a commitment in serving the community. In the face of rapid technological advancements, which present challenges in balancing innovative design ideas with practical user requirements, this study provides valuable insights in enhancing public hospitals through thoughtful architectural considerations. Architects play a crucial role in designing modern, efficient, and patient-centred hospitals. To integrate technology effectively into hospital design, architects must stay proactive, continuously learn, and collaborate with others. The recommendations for future hospital design accentuate the importance of evidence-based spatial planning, the incorporation of technological advancements, and the flexibility to accommodate evolving healthcare needs. Partnership with healthcare professionals, research initiatives, and regular updates to design guidelines and relevant legislation are essential to ensure that hospital facilities continually evolve to provide optimal patient care and remain at the forefront of healthcare innovation. This comprehensive and adaptive approach will contribute to the creation of healthcare spaces that meet the dynamic challenges of the future while prioritising the well-being of patients and communities.

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