

The impact of biophilic and human-centric design on patient outcomes in hospital inpatient department

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Abstract

Hospital inpatient environments play a significant role in influencing the physical, psychological, and emotional well-being of patients during treatment and recovery. Traditional healthcare architecture has often prioritized clinical efficiency and technological functionality, while the experiential and human-centered aspects of healing environments received limited attention. In recent years, growing interest in biophilic and human-centric design approaches has transformed the understanding of healthcare spaces by emphasizing the relationship between the built environment, nature, and human well-being. This research investigates the impact of biophilic and human-centric design strategies on patient outcomes within hospital inpatient department. The study explores how architectural elements such as natural daylight, ventilation, visual connection to nature, therapeutic landscapes, spatial comfort, privacy, acoustic control, and patient-centered spatial planning contribute to reducing stress, improving emotional stability, enhancing recovery experiences, and supporting overall patient wellness. Using a qualitative research methodology based on literature review and evidence-based healthcare design studies, the paper examines the relationship between architectural environments and patient wellness. The findings suggest that inpatient environments designed with biophilic and human-centric principles positively affect patient satisfaction, psychological comfort, recovery experiences, and overall healthcare quality.

This research paper aims to explore how wellness-centered architectural strategies can transform hospital inpatient departments into healing environments that support holistic well-being (Kellert, Heerwagen and Mador, 2008).

Keywords: Biophilic design; Supportive design theory; Human-centric design; Healing environment; Inpatient department; Healthcare interior; Stress reducing environment

1. Introduction

For centuries, people have believed that the surrounding environment plays a significant role in influencing human health and well-being. Since early civilizations, elements such as nature, fresh air, and sunlight have been recognized as important factors that contribute to physical and psychological health outcomes (Ulrich, 1991).

The built environment impacts the physical and mental condition of human health and well-being. Healing architecture is an approach being explored and implemented, particularly in healthcare facilities, to promote wellness through thoughtful design of buildings. By integrating elements such as natural light, ventilation, biophilic design, acoustics, and colour, healing architecture aims to create environments that support physical rejuvenation and mental restoration (Lawson, 2010).

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The rapid population growth in Delhi has placed immense pressure on the city's healthcare infrastructure and overall living conditions. Increasing urban density, stressful lifestyles, environmental pollution, and social pressures have contributed to a rise in physical illnesses as well as mental health concerns among residents. High levels of stress, anxiety, and emotional exhaustion are becoming major factors that negatively affect public health and contribute to the increasing occurrence of lifestyle-related diseases. As a result, there is an urgent need for healthcare facilities that not only address medical treatment but also support mental and emotional well-being. In this context, wellness-centered inpatient departments designed with biophilic

principles can play a significant role in improving patient recovery experiences (Ulrich, 1991). By incorporating natural elements such as daylight, greenery, healing gardens, fresh air, and calming therapeutic spaces, biophilic hospital environments can help reduce stress, promote relaxation, and create supportive healing environments that enhance overall patient well-being (Wilson, 1984).

Healthcare environments are more than spaces for medical treatment; they are environments that directly affect human emotions, psychological stability, and healing experiences. Among healthcare facilities, inpatient departments represent one of the most sensitive architectural environments because patients spend extended periods in these spaces while experiencing physical pain, emotional stress, anxiety, and uncertainty. The architectural quality of inpatient settings therefore plays a crucial role in influencing patient well-being and recovery outcomes (Ulrich, 1991).

Historically, hospital design has prioritized clinical functionality, technological integration, and operational efficiency. As a result, many hospital environments developed institutional characteristics that often-ignored human comfort and emotional needs. Patients in such environments frequently experience stress, sensory discomfort, lack of privacy, and emotional isolation. Contemporary healthcare research increasingly recognizes that the built environment can either support or hinder healing processes (Ulrich, 1991).

Biophilic design and human-centric design have emerged as important architectural approaches that focus on improving the relationship between people and their environments. Biophilic design integrates natural elements into built spaces to strengthen human connection with nature, while human-centric design emphasizes emotional comfort, dignity, accessibility, and user experience. Together, these approaches create healthcare environments that support holistic well-being (Kellert, Heerwagen and Mador, 2008).

This research explores the impact of biophilic and human-centric design strategies on patient outcomes within hospital inpatient settings. The paper examines how architectural interventions can contribute to healing environments that promote recovery, reduce stress, and improve patient experiences.

Wellness has become an essential component of sustainable development and is closely connected to global objectives such as Sustainable Development Goal 3, which focuses on good health and well-being, and Sustainable Development Goal 11, which promotes sustainable and inclusive communities. These goals emphasize improving physical and mental well-being for people of all age groups by encouraging accessible healthcare services, preventive healthcare approaches, stress reduction, and the management of mental health challenges while decreasing excessive dependence on medication. They also highlight the importance of creating environments that are safe, inclusive, and environmentally responsible. In urban contexts, sustainably designed wellness centers can contribute significantly to enhancing both human well-being and environmental quality, ultimately improving overall quality of life (World Health Organization, 2021).

2. Methodology

The study begins with an extensive review of literature related to healthcare architecture, healing environments, and evidence-based healthcare design to establish a theoretical foundation for the research.

The methodology further explores principles of biophilic, salutogenesis, theory of supportive design and human-centered design to understand how natural elements and patient-focused spaces can contribute to physical and psychological healing. Different environmental factors such as daylight, natural ventilation, greenery, spatial planning, acoustics, privacy, and interior comfort are analysed to evaluate their impact on patient recovery, stress reduction, and overall hospital experience.

The collected information is then used to develop design considerations and recommendations for creating wellness-centered hospital environments that support healing, comfort, and emotional well-being for patients, visitors, and healthcare staff.

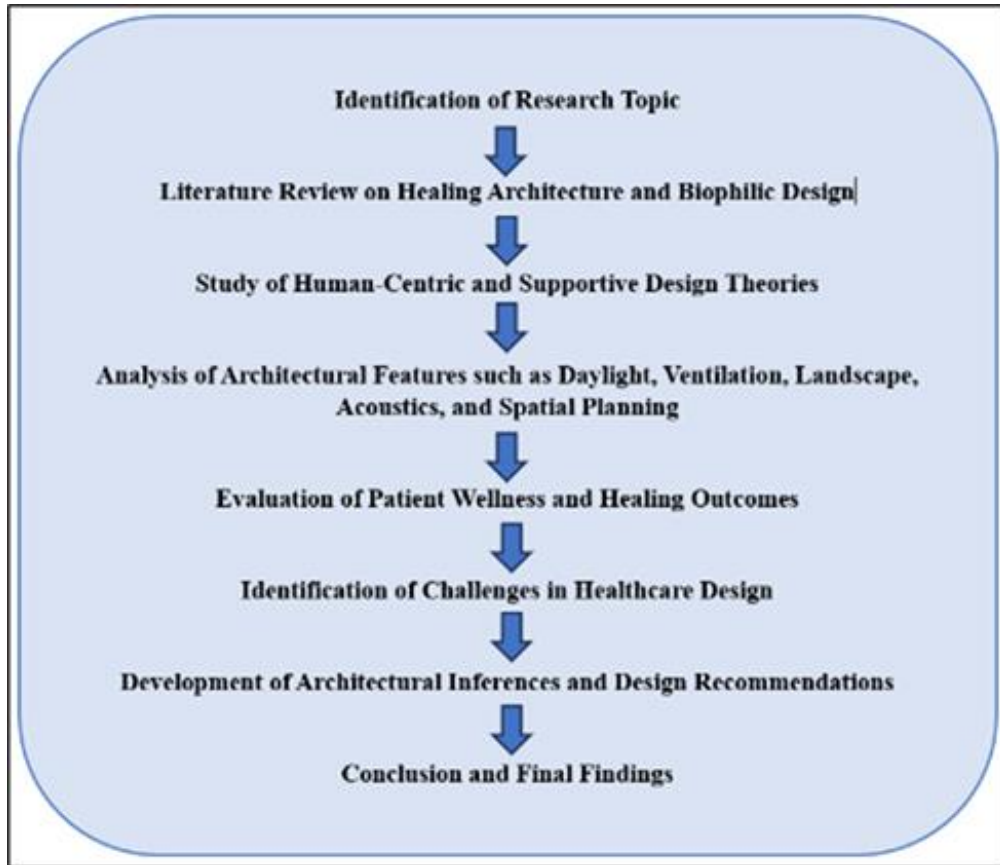


Figure 1 Methodology

3. Literature Review

3.1. Healing Architecture and Natural Therapeutic Environments

Healing architecture refers to the design of spaces that support physical, psychological, and emotional well-being through environmental qualities such as nature, light, water, ventilation, and sensory comfort. In traditional Indian settlements, healing environments often emerged around natural elements like hot springs, rivers, forests, and mineral-rich water sources. Places such as Mankiran and Sharadha represent significant examples where natural resources influenced the development of healing-oriented spaces and architectural patterns.

3.2. Historical Background of Healing Architecture in Mankiran

Manikaran is located in the Parvati Valley of Himachal Pradesh and is historically known for its geothermal hot springs. The settlement has long been regarded as a spiritual and therapeutic destination due to the presence of naturally heated mineral water believed to possess healing properties. Historically, pilgrims, travelers, and local communities visited the site for relief from skin diseases, joint pain, and muscular disorders.



Figure 2 Manikaran: Amidst hot springs and spirituality

The architectural development of Mankiran evolved around these hot springs. Traditional bath structures, resting spaces, prayer halls, and community shelters were constructed near the thermal water sources to support healing rituals and spiritual practices. The integration of water, mountain landscapes, and naturally ventilated structures created a restorative atmosphere that aligned with early concepts of wellness-centered environments.

3.3. Historical Background of Healing Architecture in Sahastradhara –

Sharadha, meaning “thousand-fold spring,” is historically recognized for its sulfur-rich water springs and caves. The site has been valued for centuries for its medicinal water, which is traditionally believed to help treat skin ailments and improve physical health. The natural dripping waterfalls and mineral springs created a healing landscape that attracted visitors seeking therapeutic relief and mental relaxation.



Figure 3 Sahastradhara Dehradun: Explore the Sulphur Springs and Healing Waters of Uttarakhand

The environmental qualities of Sharadha contributed significantly to psychological restoration. The sound of flowing water, cool microclimate, natural caves, and green surroundings created a calming sensory environment. Traditional healing practices often combined hydrotherapy, spiritual reflection, and exposure to nature.

When individuals experience stress, fatigue, or emotional discomfort, many tend to seek comfort in environments connected to nature, including both natural landscapes and intentionally designed green spaces, as these settings often promote relaxation and psychological well-being (Lawson, 2010).

3.4. Wellness focused design in healthcare environment

The design of healthcare facilities has increasingly shifted toward approaches that prioritize patient well-being and holistic healing. In 1984, Edward O. Wilson introduced the concept of "Biophilia," which describes the innate human tendency to seek connections with nature and natural systems. This idea later influenced the development of biophilic design, an approach that integrates natural elements into built environments to support human health, comfort, and productivity.

Biophilic design is founded on the understanding that continuous interaction with nature can positively influence mental, emotional, and physical health, even within highly urbanized or clinical environments. In healthcare architecture, this approach is applied through strategies such as maximizing natural daylight, providing views of landscapes, incorporating indoor vegetation, using natural materials, and creating healing gardens and restorative spaces (Kellert, Heerwagen and Mador, 2008).



Figure 4 Health and psychological benefits of biophilic design

3.5. Biophilic Design in Healthcare

The concept of Biophilia was introduced by Edward O. Wilson in 1984, describing the innate human tendency to connect with nature. Biophilic design applies this concept within architecture by integrating natural elements into built environments.

3.5.1. In healthcare facilities, biophilic strategies include

- Healing gardens
- Indoor vegetation
- Natural daylight
- Water features
- Natural ventilation
- Nature views
- Organic materials and textures

Research indicates that these elements help reduce stress, lower anxiety, improve mood, and accelerate patient recovery. Patients exposed to natural environments often demonstrate improved emotional responses and greater satisfaction with healthcare experiences (Ulrich, 1991).

3.6. Human-Centric Design

Human-centric healthcare design emphasizes emotional comfort, patient dignity, accessibility, privacy, and supportive environments. Unlike conventional institutional hospitals, human-centered healthcare spaces focus on user experience and psychological well-being (Lawson, 2010).

3.6.1. Key principles include

- Intuitive wayfinding
- Privacy and personal control
- Comfortable interiors
- Family-centered spaces
- Positive sensory environments
- Social interaction areas

These strategies contribute to reducing fear, anxiety, and emotional stress among patients and caregivers.

3.7. Theory of Supportive Design

Roger S. Ulrich proposed the Theory of Supportive Design to explain how healthcare environments can reduce stress and support healing. According to the theory, hospital spaces should provide psychological comfort by promoting a sense of control, social support, and positive distractions.

3.7.1. The theory is based on three major principles

- Perceived Control – Patients should feel a sense of control over their surroundings through features such as adjustable lighting, privacy, easy wayfinding, and comfortable personal spaces.
- Social Support – Healthcare environments should encourage interaction and emotional support between patients, families, and caregivers through family lounges, waiting areas, and social spaces.
- Positive Distractions – Natural elements such as gardens, daylight, water features, artwork, and views of nature help reduce stress, anxiety, and mental fatigue (Ulrich, 1991).

Ulrich's theory emphasizes that supportive healthcare environments can improve patient satisfaction, reduce stress levels, and contribute positively to recovery outcomes (Ulrich, 1991). It has become an important foundation for biophilic and human-centric healthcare design.

3.8. Example of hospital connecting with nature (biophilic hospital case study)

Dells children's medical center – It is considered one of the best example of sustainable and healing healthcare architecture located in Austin. The hospital was designed with a strong focus on patient-centered care, environment sustainability and therapeutic healing environment. The project becomes internationally recognised as one of the first hospital to achieve LEED platinum certification. This hospital serves as an important example of how biophilic and human-centric design principle can positively influence patient recovery, emotional comfort and healthcare experiences (Ulrich, 1991). within inpatient departments.



Figure 5 Dell Children's Medical Center, Austin, Texas, USA

- A hub and spoke design incorporate seven interior courtyards that bring natural light throughout the building
- A Sensory Garden area that uses plants and other elements with unique textures, colors, smells and tastes to stimulate the senses
- Landscaping featuring a natural palette of indigenous plants, in line with the overarching theme of our “green” building
- Family Lounges are located directly outside each patient unit on 2nd, 3rd and 4th floors. They're available 24 hours a day.
- The Family Resource Center is located near the main entrance on the 3rd floor. The Center offers resources ranging from computers to books and DVDs, and a medical librarian is available during daytime hours.
- Circular eight-room pods have a nursing station just outside the doors of every patient room.
- Family Sleeping Accommodations are part of every child's room.



Figure 6 biophilic design features such as landscaped healing gardens



Figure 7 Dell Children's Medical Center, Layout plan

Table 1 Dell Children's Medical Center highlighting the application of biophilic and child-centered healthcare design

s.no	Architecture feature	Literature review	Architecture inference
1	Healing Gardens and Outdoor Therapeutic Spaces	The hospital incorporates healing gardens and landscaped outdoor areas that provide children and families with opportunities for relaxation and interaction with nature. These gardens create restorative spaces away from clinical settings.	Access to outdoor natural environments reduces anxiety, supports emotional healing, and improves patient well-being.
2	Extensive Use of Natural Daylight	Large windows, glazed openings, and daylight-oriented planning strategies allow natural light to penetrate patient rooms, corridors, and waiting areas.	Daylight improves mood, reduces stress, and creates a more positive healing environment for pediatric patients.
3	Nature-Oriented Patient Rooms	Patient rooms are designed to provide views of landscapes and outdoor greenery whenever possible. The visual connection with nature creates calming psychological effects for children undergoing treatment.	Visual access to nature contributes to emotional comfort and supports recovery processes in healthcare environments.
4	Child-Friendly Interior Design	Bright colors, playful forms, artwork, and interactive interior elements are incorporated to create welcoming and non-threatening environments for children.	Pediatric-focused interior design reduces fear and creates emotionally supportive healthcare experiences.
5	Open Social and Community Spaces	Shared lounges, gathering spaces, and interactive public areas encourage social interaction among patients, families, and caregivers.	Social interaction spaces promote emotional healing and create supportive community environments within healthcare settings.



Figure 8 Interior healing courtyard at Dell Children's Medical Center

3.9. Khoo Teck Puat Hospital

It is internationally recognized as one of the most successful examples of biophilic and healing-centered healthcare architecture. Designed with the concept of a "hospital in a garden and a garden a hospital," the project integrates nature, sustainability, and patient-centered planning to create a therapeutic healthcare environment.

Designed as a V-shaped configuration of blocks, The 'V' opened to the north, letting in breezes that first, skim over an existing storm-water pond, adjacent to the hospital site. To tap into this natural airflow, the envelope of the buildings had to calibrate permeability and shade. The goal was to allow patients access to natural light, cooling breezes and views, without risk of solar glare or rain entry.



Figure 9 Khoo Teck Puat Hospital, Singapore

To make the hospital a “biophilic environment”, every available surface had to be maximized for the creation of therapeutic green spaces. Extensive landscaping at every floor ensures that patients and staff are in close proximity to the calming and rejuvenating environment so they can be constantly treated to garden views from multiple angles.

Each unique roof garden is engaging and educational. The rooftop farm at the Specialist Outpatient Clinic Block has 100 species of fruit trees, 50 species of vegetables and 50 species of herbs.

Another highlight is the terraced gardens at the podium roof deck levels of the Private and Subsidized ward towers.



Figure 10 Landscape Plan of Khoo Teck Puat Hospital

Table 2 Demonstrating Biophilic Healthcare Design Strategies and Healing Environment Principles. Khoo Teck Puat Hospital

s.no	Architecture feature	Literature review	Architecture inference
1	Biophilic Design Integration	The hospital integrates vegetation, water bodies, natural light, and open landscapes into the built environment to strengthen the relationship between nature and healing spaces. Greenery is incorporated from ground level to rooftop gardens and balconies	Continuous interaction with nature creates restorative healthcare environments that reduce patient stress and support emotional healing, well-being.
2	V-Shaped Building Configuration	The hospital is designed in a V-shaped massing arrangement that opens toward prevailing winds and surrounding landscape areas. This planning strategy enhances airflow and environmental connectivity	Building orientation can improve natural ventilation, reduce energy consumption, and increase thermal comfort in healthcare environments.
3	Extensive Vertical Greenery	Vertical gardens and planted façades cover large portions of the hospital exterior and interior courtyards. The greenery also attracts birds and butterflies, creating a living ecosystem.	Vegetation softens the institutional character of hospitals and improves psychological well-being through visual and sensory interaction with nature.
4	Water Features and Healing Landscapes	Water bodies connected to nearby ponds are integrated into the landscape design. The sound of flowing water creates a calming sensory environment for patients and visitors	Sensory healing through sound and visual connection to water contributes to relaxation and emotional restoration.

5	Rooftop Therapeutic Gardens	Rooftop gardens and sky terraces provide spaces for relaxation, gardening activities, and therapeutic interaction with nature.	Elevated healing landscapes support mental restoration and encourage social interaction among patients and visitors.
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Figure 11 ky Gardens and Vertical Greenery at Khoo Teck Puat Hospital

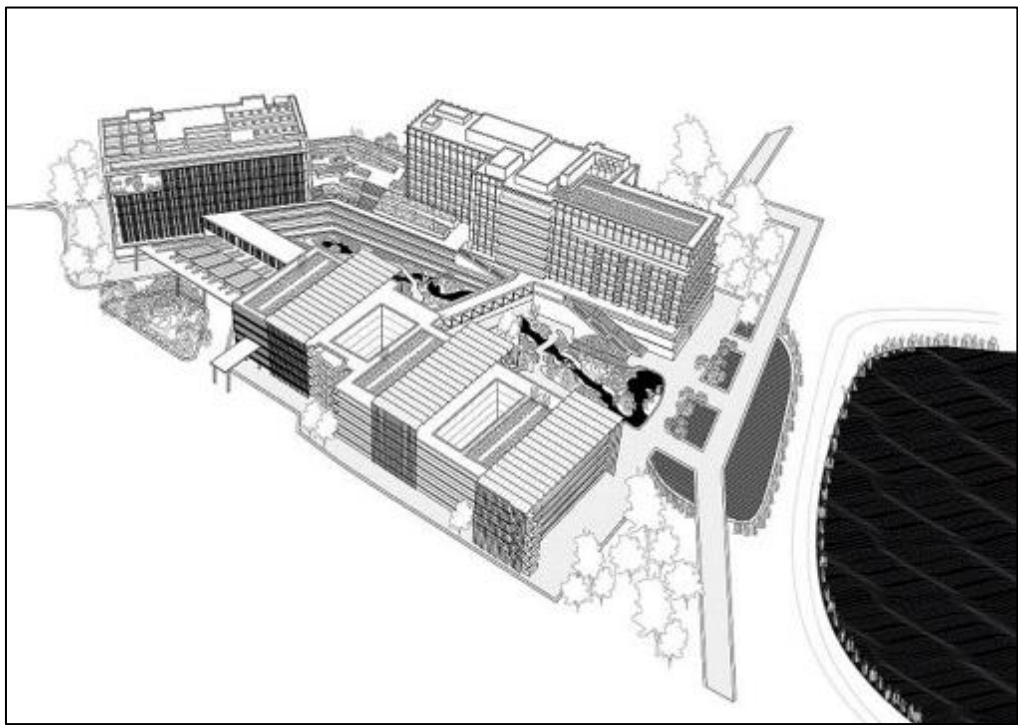


Figure 12 Conceptual Architectural Massing and Courtyard Planning of Khoo Teck Puat Hospital Illustrating Integrated Biophilic Healthcare Design Strategies



Figure 13 Integrated Sky Bridges and Vertical Biophilic Landscapes

4. Sarvodaya Hospital Greater Noida

- Location – Gaur city 2 Greater Noida, N.C.R
- Type – multi-specialty general hospital
- Architectural approach – Biophilic+ health architecture
- Capacity – 200 to 300 beds
- Site nature – Urban healthcare infrastructure

Healthcare architecture today is shifting from conventional institutional planning toward healing-oriented environments that improve patient wellness, emotional comfort, and environmental quality. Biophilic design integrates natural elements such as daylight, landscape, vegetation, natural ventilation, and visual connectivity with nature into healthcare environments (Kellert, Heerwagen and Mador, 2008).

This hospital is an important contemporary example of adaptive and biophilic healthcare architecture in Delhi NCR

The hospital is designed with a strong focus on healing architecture and environmental wellness. Natural light, landscaped areas, open circulation spaces and visual connection with greenery are integrated into the planning. The project demonstrates how hospital environments can reduce stress and improve psychological comfort for patients, visitors and staff.

4.1. Site characters

- Located within a rapidly developing urban healthcare zone.
- Good accessibility from major NCR roads.
- Open surroundings allow natural ventilation and daylight penetration.

Architectural concept - The project was developed through adaptive reuse of a mixed-use commercial building into a multi-specialty hospital. The architects transformed fragmented blocks into an integrated healing environment using daylight-filled circulation spaces, interior courtyards, and wellness-oriented interiors.



Figure 14 4. Sarvodaya Hospital Greater Noida



Figure 15 Reception of Sarvodaya Hospital Greater Noida

Table 3 Demonstrating Biophilic and Healing-Centered Design Strategies in Contemporary Healthcare Architecture

s.no	Architecture feature	Literature review	Architecture inference
1	Natural Daylighting	Design states that daylight improves patient recovery, reduces stress, and enhances emotional wellbeing in healthcare spaces.	Large glazed openings, atriums, and courtyards in the hospital improve indoor environmental quality and reduce dependency on artificial lighting.
2	Healing Landscape	Biophilic Design Theory emphasizes that interaction with greenery and natural environments positively affects mental health and healing.	Landscaped courts and green visual connections create calming and restorative spaces for patients and visitors.
3	Nature-Oriented Patient Rooms	Patient rooms are designed to provide views of landscapes and outdoor greenery whenever possible. The visual connection with nature creates calming psychological effects for children undergoing treatment.	Visual access to nature contributes to emotional comfort and supports recovery processes in healthcare environments.
4	Adaptive Reuse Strategy	Sustainable architecture studies support adaptive reuse for reducing environmental impact and promoting resource efficiency	Conversion of a commercial structure into a hospital demonstrates sustainable and efficient redevelopment.
5	Courtyard Planning	Traditional and contemporary healthcare studies suggest courtyards improve ventilation, social interaction, and daylight penetration.	Interior courtyards enhance openness, spatial comfort, and passive environmental performance.
6	Natural Colour Palette	Interior healthcare research states that earthy colours and soft textures contribute to a calming healing atmosphere.	Warm and natural interior finishes reduce psychological stress and create a soothing environment.

5. Challenges In Implementing Biophilic and Human-Centric Healthcare Design

Despite the growing recognition of biophilic and human-centric design in healthcare environments, the practical implementation of these approaches within hospital architecture continues to face several limitations.

Financial Constraints - One of the primary challenges the issue of cost. Hospital projects generally allocate a significant portion of their budgets toward advanced medical equipment, structural systems, and technological infrastructure required for clinical operations. As a result, design elements such as indoor gardens, therapeutic landscapes, natural ventilation systems, daylight optimization, and patient-centered interior features are often considered secondary priorities.

Space Limitations - The integration of biophilic design strategies is particularly difficult in densely populated urban areas where hospitals are often constructed on limited land and the availability of open spaces for healing gardens, courtyards, and outdoor therapeutic environments becomes restricted. High-rise healthcare buildings may prioritize maximum floor area utilization, leaving minimal opportunity for natural landscapes or restorative outdoor spaces. This limitation affects the ability of architects to establish direct connections between patients and nature, which is a fundamental principle of biophilic design.

Maintenance Requirements - Biophilic healthcare environments require continuous maintenance to ensure their functionality, safety, and aesthetic quality. Natural elements such as indoor plants, water features, green walls, and landscaped areas demand regular care, irrigation, cleaning, and monitoring. In healthcare settings, poorly maintained natural features may negatively affect the visual quality of the environment. maintenance costs associated with living systems can become significant over time.

Infection Control Concerns - Healthcare environments operate under strict hygiene and infection-control regulations intended to protect patients, staff, and visitors from contamination and disease transmission. Certain natural materials,

water installations, or dense vegetation may raise concerns regarding moisture accumulation, microbial growth, allergens, or airborne contaminants. As a result, healthcare guidelines may restrict the use of specific biophilic elements within sensitive clinical areas such as intensive care units, operating departments, and isolation wards

6. Findings

- The study identifies several positive impacts of biophilic and human-centric healthcare design on patient outcomes
- Natural daylight improves emotional well-being and reduces stress.
- Visual connection with greenery contributes to psychological comfort.
- Healing gardens support emotional restoration and relaxation (Marcus and Barnes, 1999).
- Acoustic comfort reduces anxiety and sensory stress.
- Family-centered spaces improve social support systems.
- Nature-integrated environments enhance patient satisfaction and recovery experiences (Ulrich, 1991).
- Human-centric planning creates dignified and emotionally supportive healthcare environments (Kellert, Heerwagen and Mador, 2008).

The research demonstrates that wellness-centered healthcare architecture can significantly improve the quality of inpatient healing environments (Lawson, 2010).

7. Conclusion

Biophilic and human-centric healthcare design has emerged as an important approach for improving patient wellness, emotional comfort, and healthcare quality within hospital inpatient departments. Unlike conventional institutional healthcare environments, wellness-centered hospitals integrate nature, sensory comfort, and user-oriented planning strategies to create restorative healing spaces.

The findings of this research indicate that architectural interventions such as daylight optimization, therapeutic landscapes, healing gardens, natural ventilation, and patient-centered interiors positively influence patient outcomes by reducing stress, improving emotional stability, and supporting recovery experiences (Ulrich, 1991).

As healthcare architecture continues to evolve, future hospitals should prioritize holistic healing environments that balance medical functionality with human well-being. Integrating biophilic and human-centric principles within inpatient departments can transform healthcare spaces into environments that not only treat illness but also promote psychological restoration, dignity, and wellness (World Health Organization, 2021).

Compliance with ethical standards

The author declares that this research work is conducted solely for academic purposes as part of the Master of Architecture study, and there is no conflict of interest regarding the publication of this manuscript

References

- [1] Ulrich, R. S. (1991). Effects of healthcare environmental design on medical outcomes. *Design and Health Proceedings*.
- [2] Wilson, E. O. (1984). *Biophilia*. Harvard University Press.
- [3] Kellert, S. R., Heerwagen, J., and Mador, M. (2008). *Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life*. Wiley Publications.
- [4] Lawson, B. (2010). *Healing Architecture*. Arts and Health Journal.
- [5] World Health Organization (WHO). (20 (Ulrich, 1984)21). *Health and Well-being in Built Environments*.
- [6] Marcus, C.C. and Barnes, M. (1999). *Healing Gardens: Therapeutic Benefits and Design Recommendations*. Wiley Publications.