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Exploring Restorative Spatial Design In Hospitals: Examining Courtyards And Green Spaces Through A Biophilic Design Perspective In Selected Hospital Settings

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Abstract: *The physical conditions in health care settings can impact the physical, mental and emotional health of patients, visitors and healthcare workers. This study is to explore and evaluate nature-integrated spaces in selected public and private hospitals in Lahore city using a structured framework of Biophilic design audit. Its research assesses how much the natural elements are used in healthcare environments and how they help to create restorative and therapeutic experiences. The results also indicate that while many hospitals have open areas (courtyards, lawns, landscaped spaces, etc.), these areas tend to be underutilized, under-maintained, and not well integrated into the overall healing process. They have restricted seating, inadequate shading, poor accessibility and inadequate landscape planning, which lessens their therapeutic value. Comparative analysis shows that, in general, private hospitals offer more aesthetically-designed and well-maintained healing environments, whereas public hospitals, due to their large spatial potential, encounter issues in maintaining the environment, in coordinating the planning of their spaces, and in integrating the biophilic approach into their spatial design. The research points towards some critical opportunities for making improvements to health care environments through nature-based solutions with low-cost benefits based on the "Hospital in a Garden" principle. It ends with design and policy suggestions on embedding biophilic planning into hospital protocols, the creation of more fluid connections between the indoor and outdoor environments, and more sustainable, therapeutic healthcare spaces for rapidly urbanizing cities.*

Keywords: Biophilic Design, Healing Environments, Hospital Landscapes, Healthcare Architecture, Therapeutic Open Spaces

INTRODUCTION AND BACKGROUND

This connection between the built environment and human psychology has been repeatedly recognized in architectural and health care studies, wherein it has been concluded that the physical context has a profound impact on the emotional state, level of stress, and the healing experience (Lacanna &

Wagenaar, 2018). Hospitals are no longer just a place to treat your illness, but a place where you can influence patient recovery, staff productivity and the experience of healthcare. In this context, nature-oriented and human-centred design methods have received significant focus in modern healthcare architecture (Momtaz & Shaban, 2018). Of these, biophilic design has proven to be a vital lens through which to explore how to reconnect humans to nature within the built environment, by introducing natural elements, environmental patterns and learning experiences (Shah et al., 2023a). Healthcare spaces can transcend the confines of the sterile clinical environment by adding elements of daylight, vegetation, water features, natural ventilation, and visual connections with outdoor spaces, thus becoming more healing spaces.

Studies in environmental psychology and evidence-based healthcare design have shown that patients' exposure to natural environments can lessen anxiety, lower blood pressure, improve mood, and speed up recovery times (Marcus, 2016). Patients, visitors and healthcare workers often exhibit lower stress levels when they encounter healing gardens, therapeutic courtyards, shaded walkways and green spaces that are accessible by sight. In hospitals, where the users are likely to have emotional distress, physical discomfort, and mental fatigue, such interventions are especially important (Paraskevopoulou & Kamperi, 2018). Nature-oriented design, thus, offers the chance to develop health care spaces that are not only functional, but also humane, comforting, and emotionally supportive. Increasingly, architects and planners around the world have begun to consider the restorative potential of nature when developing hospital design strategies.

The healthcare sector in Lahore is a mosaic of diverse urban and architectural elements, influenced by the city's dynamic growth, population surge, and evolving healthcare needs (Shah et al., 2023b). The city is home to a variety of colonial era healthcare facilities, modern private hospitals and overcrowded public medical complexes (Salahuddin et al., 2024). Even with the progress of medical technologies and healthcare infrastructure, there are still a lot of healthcare institutions in Lahore that are having environmental and spatial issues which are affecting the users' wellbeing. Many current health care facilities have a high density of people, long waiting lines, noise pollution, poor natural lighting and little access to green space. However, in many cases, hospital planning focuses on clinical efficiency and technological needs without taking into account the therapeutic effects of the surrounding environment (Bhatti et al., 2025). This often means that patients and healthcare professionals frequently find themselves in environments that are stressful and lack opportunities for mental renewal and connection with nature.

Considering the climatic and cultural setting of Lahore, it becomes even more significant to bring nature in the healthcare institutions as therapeutic environments (Shakeel & Bhatti, 2025). Lahore is one of the fast-growing cities of South Asia and due to its climate, its summers are hot, pollution level is rising and urban greenery is decreasing, which necessitates the development of healthcare environments where thermal comfort, psychological relief and environmental quality can be provided (Zulfiqar et al., 2024). The traditional architecture of the area was traditionally designed with courtyards, gardens, water elements, and shaded transitional spaces to adapt to the climatic and social conditions. In contrast, many modern developments of hospitals have ignored such spatial traditions and adopted tight and infrastructure oriented planning processes. Implementing nature-oriented design interventions in healthcare can thus be considered both a functional and culturally responsive and sustainable intervention (Ali et al., 2024).

The biophilic design concept is rooted in the “biophilia hypothesis” that implies humans have an emotional and psychological attraction to nature. In the medical building, this idea manifests itself in the development of healing rooms that promote relaxation, lower tension, and improve emotional improvement. Restorative courtyards, therapeutic gardens, aligned exterior environments and landscaped pathways are just a few of the interventions that positively affect the patient experience and healthcare outcomes. These areas also help to facilitate social interaction, sensory stimulation and better

working conditions for medical staff. Although the healthcare environment with a biophilic approach has been recognized internationally, there is a lack of research into its implementation and effectiveness in the context of Pakistani hospitals, especially in Lahore. As a result, it is crucial to gain insights into the quality, availability, and effectiveness of current healing spaces in healthcare institutions in Lahore to create future more sustainable, healing, and patient-friendly hospital environments.

PROBLEM STATEMENT

Though there is a solid evidence of the therapeutic values of natural and restorative environments in hospitals, the majority of hospitals in Lahore are still lacking in integrating them into the hospitals. Hospital courtyards, gardens, and open spaces can be poorly designed, underused, or not part of the healing environment, and are more likely to be perceived as "out of the way" spaces than active therapeutic spaces. Moreover, there is a lack of structured frameworks and biophilic design audits to assess the effectiveness and restorative value, and accessibility of these spaces. Poor environment is linked to greater psychological stress, lower comfort level for patients and healthcare personnel and unmet needs for nature-based interventions to enhance recovery experiences, which leads to all of these. With the rapid urbanization of the healthcare sector in Lahore, it is imperative to critically analyse the state and functioning of current healing spaces and to develop plans to include biophilic design principles during the hospital planning and design process.

RESEARCH OBJECTIVES

Following were the major key research objectives set forth:

1. To evaluate the existing condition and functional performance of courtyards, gardens, and healing spaces in selected public and private hospitals in Lahore through a biophilic design framework.
2. To identify opportunities and design strategies for enhancing therapeutic and nature-integrated healthcare environments in Lahore hospitals.

RESEARCH SIGNIFIFCNACE

The study is relevant because it shows the importance of the relationship between the healthcare architecture, environmental quality and human health in the context of fast urbanizing cities like Lahore. Today's hospital design and planning focus on medical technologies and efficiency, but the therapeutic benefits of natural environments are largely underutilized. This study is a contribution to the ongoing debate on evidence-based and patient-centred healthcare architecture and its evaluation based on a biophilic design lens with regard to the courtyards, gardens and healing spaces. The findings of the research are of great value in understanding the contribution of nature integrated environments to enhance psychological comfort, stress reduction, patient recovery and wellbeing of staff. Moreover, it caters to the research gap in the Pakistani context where not much attention has been paid so far towards the evaluation of therapeutic landscapes in the Hospitals. The results of this study can inform architects, planners, healthcare administrators, and policy makers on how to implement design features into health care settings that are more sustainable and compassionate without being too costly or impractical. Further, the study advocates for incorporating biophilic design elements into future design standards for hospital buildings, with a view towards making hospitals more than just a place for diagnosis and treatment, but more of a place for healing.

DELIMITATION OF STUDY:

This study specifically focuses on public and private hospitals in the Greater Lahore Metropolitan Area. While it explores spatial and architectural elements, its scope is limited by the availability of historical architectural drawings and the current state of site maintenance. The audit will primarily focus on physical design indicators rather than long-term clinical data.

LITERATURE REVIEW:

Nature-Integrated Design in Contemporary Healthcare Architecture

The built environment-nature relationship is a growing issue that has been a focus in the architectural discourse today, especially in the field of healthcare design (Jiang, 2014). Today's healthcare building design concept has shifted from a traditional definition of the hospital as a place for clinical care to a holistic acknowledgment of the significance of emotional, psychological and environmental health in the healing journey (Красильникова et al., 2021). Designs that incorporate daylight, plants, water features, natural ventilation and outdoor restorative spaces aim to create meaningful links between the people in the building and the nature. They are based on the principles of environmental psychology, which state that humans respond favourably to environments that replicate natural environments. Nature elements can also have a calming and soothing effect in healthcare settings, where patients may be experiencing stress, anxiety, and physical discomfort, helping to promote a sense of relaxation and emotional stability (He-xia, 2009).

Healthcare facilities in urban areas, especially in fast-growing cities like Lahore, are often congested, noisy, under equipped with green spaces, and over-developed. In a highly populated urban area hospitals are typically built with a high emphasis on operational efficiency and medical technology, while the therapeutic value of architecture and landscape is often ignored (Belčáková et al., 2018). This has led to sterile and stressful environments which can have a negative impact on patient and health care worker. It is the idea of a designing of healthcare, which integrates nature, and being based on the concept of human comfort, sensory involvement and environmental quality (Staniewska, 2022). Garden spaces, courtyards, shaded walkways and views to greenery can help to reduce stress, enhance the building environment and encourage social interaction in healthcare environments. With rising urbanization and growing climate pressures, the need for urban nature to improve health care environments becomes more critical, particularly when it comes to developing sustainable, humane, healing environments (Lestari & Favurita, 2024).

Biophilic Urbanism and the Evolution of Healing Environments

Biophilia' is the term coined by Edward O. Wilson, which suggests that there is a natural connection between people and nature/nature systems. The theory has had a profound impact on urban design, architecture, and environmental design, particularly in promoting the psychological and physiological advantages of human connection with nature. Biophilic design in healthcare settings goes beyond visual landscaping and instead, emphasizes the creation of places that are health promoting and uplifting to people (Nieberler-Walker et al., 2023). The use of natural light, greenery, organic shaping, air motion and the provision of sensory experiences is incorporated within architectural environments to enhance comfort, decrease stress and increase emotional resilience. Biophilic design in healthcare spaces is therefore concerned with the health recovery experiences of the space, not just the healing of the disease, but also experiences of healing through the space's spatial qualities and environment (Naderi & Woo-Hwa, 2008).

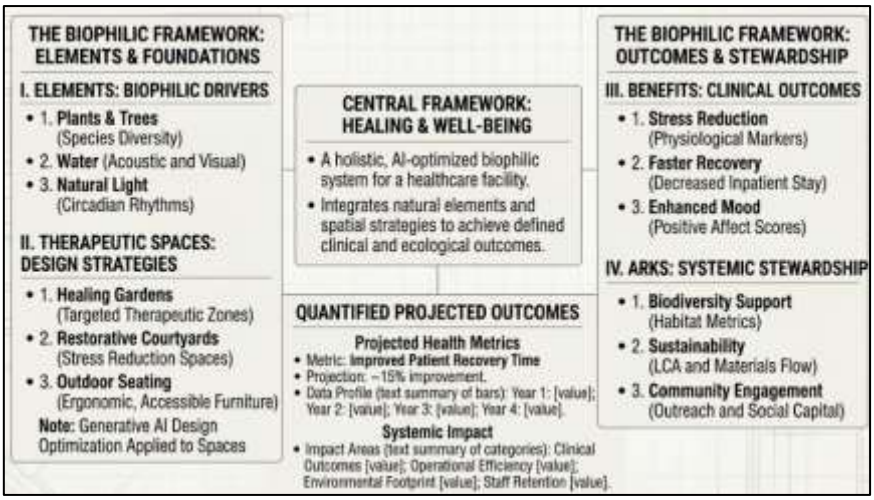

Figure 01 Biophilic Hospital Ecosystem Framework

Today, the healing environment is shifting from technology dominated healthcare settings to patient-centred and evidence-based design, which is reflected in its evolution. The first hospital models focused mainly on the issue of sanitation, in addition to the functionality and mechanical efficiency of the operation. Recent studies, however, have shown that environmental factors have a significant impact on patient outcomes, mental health, and employee productivity. Some scholars, including Timothy Beatley, have stated that biophilic cities are more than just urban environments with plants; they are environments where nature is used in daily life and within institutional structures. Taking this lesson to hospitals, therefore, it seems logical to view health care as a restorative ecology instead of a medical system (Dushkova & Ignatieva, 2020). The use of biophilic elements in the design of hospitals can lead to a more calming environment, higher patient satisfaction, and a better working environment for healthcare workers. In this context, biophilic urbanism has turned into a fundamental design approach to address both human and environmental demands in the rapidly-urbanizing context of healthcare spaces (Marcus & Barnes, 1999).

Therapeutic Landscapes and the "Hospital in a Garden" Approach

"Hospital in a Garden" is a radical idea in the field of hospital architecture, in which the hospital is integrated in a therapeutic landscape, rather than being surrounded by isolated ornamental plants. The concept of the "garden in a hospital" is turned on its head in this model, with nature becoming a major spatial and environmental influencing factor in healthcare planning. The method understands not only that healing is affected by medical care but also by the environmental experiences that help to minimize stress and create psychological comfort. A mix of gardens, courtyards, walking trails, shady outdoor seating and water features make for restorative spaces that promote emotional health and sensory stimulation. These areas offer patients, visitors and healthcare staff a chance to unwind, reflect and connect with others (Sherman et al., 2005).

It has been shown that therapeutic landscapes can be implemented in healthcare facilities effectively, as seen in international cases from countries like Singapore and Scandinavian countries. Dense urban hospitals like Khoo Teck Puat Hospital have successfully integrated biodiversity, rooftop gardens, natural ventilation and connected green spaces into the hospital environment (Relf, 2019). These spaces de-institutionalize the hospital and foster welcoming and restorative spaces. Therapeutic landscapes also help to promote air quality, biodiversity and mitigate urban heat island effects, thus contributing to environmental sustainability. The "Hospital in a Garden" model is significant for thinking about healthcare spaces in the context of Lahore, where hospitals are often crowded and have poor environmental quality, both in terms of ecology and social context, as they are envisioned as combined ecological and social spaces that allow for the healing of humans and the strengthening of ecological and social systems (Nieberler-Walker et al., 2024).

Healing Gardens, Sensory Spaces, and Patient Well-Being

Healing gardens are outdoor spaces specifically and deliberately created for therapeutic experiences related to the multisensory interaction with nature. Healing gardens are planned to provide psychological restoration, emotional comfort and cognitive relief, whereas decorative or ornamental gardens are planned differently. Often featured elements in these areas include plants, seating areas, fountains, walkways, mirrors, and interesting arrangements of colors and patterns, which can all contribute to alleviating stress and mental fatigue (Hastuti & Lorica, 2020). Patients are at risk of experiencing anxiety, fears, isolation and emotional fatigue when receiving healthcare services. Healing gardens offer a temporary respite from the hospital environment, allowing patients to experience nature's rhythms and sensations which help to maintain emotional balance and relaxation.

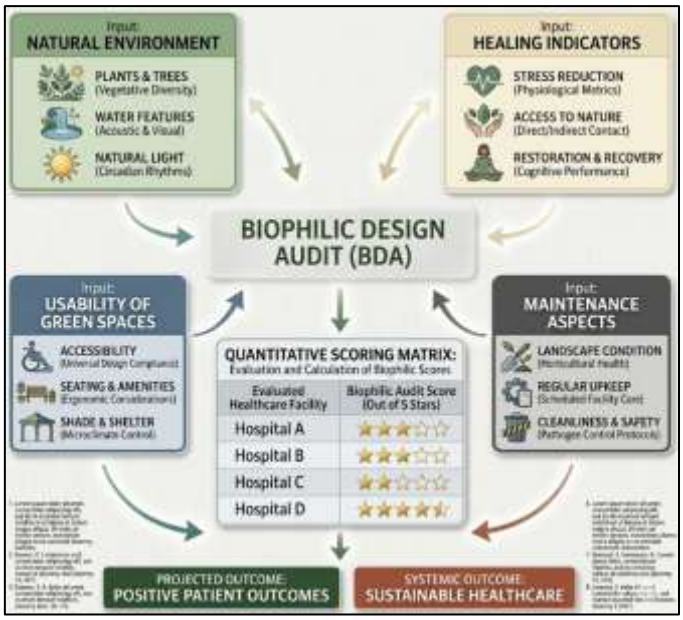

Figure 02 Biophilic Design Audit aspects

A number of studies in healthcare and environmental psychology have consistently shown that there is a correlation between patient outcomes and exposure to nature. When patients have access to a garden, to daylight, to greenery, it's been shown to decrease cortisol levels, decrease blood pressure, recover faster, reduce the amount of pain medicine required (Martin et al., 2021). Therapeutic landscapes can also support the mood and decrease depression among long-term patients, both visually and physically accessible. Moreover, nature-integrated environments benefit healthcare workers by lowering the occupational stress and improving satisfaction in the workplace. Sensory experiences: Smell, sound, touch and visual experiences are used to create restorative experiences that enhance concentration and emotional resilience. Healing gardens could serve as important therapeutic environments in healthcare systems in urban areas where stress, pollution, and population growth are happening, like Lahore(Paraskevopoulou et al., 2020). They play a crucial role in enhancing patient recovery experiences, fostering a more compassionate and emotionally supportive healthcare environment, and facilitating hospital planning.

Ecological Healthcare Environments and Research Gaps in Lahore

Modern hospitals design are now increasingly aware of the environmental function of the hospital in the urban environment (Rawlings, 2017). Hospitals can be ecological sanctuaries, part of the environment that can support biodiversity, enhance environmental quality and enhance the resilience of the city. This view is to see the hospitals as a whole system environment in which human healing and the care of the environment go hand in hand. Healthcare facilities can become sustainable settings through the use of native vegetation, green corridors, water conservation measures, and biodiversity-

friendly designs (Carroll et al., 2023). These methods can be especially significant in fast-growing urban areas where ecological fragmentation and environmental degradation are worsening. Hospitals, with their size of land and importance as institutions, can thus play a significant role in the urban ecological network and improve the therapeutic experience for users (Wang & Tzortzi, 2023).

Although there is a great amount of international research accumulated on biophilic healthcare environments, a few studies have explored the significance of biophilic healthcare environments in the Pakistani context, especially at Lahore. Conventional literature tends to concentrate on the functionality of the hospital, the infrastructure and the everyday functioning of the hospital, neglecting the therapeutic and ecological aspects of healthcare environments (Pasha & Shepley, 2013). Furthermore, currently there are no formal mechanisms to inspect the quality, availability and impact of hospital courtyards, gardens and healing spaces in the healthcare facilities in Lahore. Lahore has distinctive climatic conditions, cultural practices, population density and urban development patterns which are distinct from international case studies. Thus, a direct replication of global health care models might not be suitable to address local environmental and social conditions. This study thus fills an important gap by translating international definitions of biophilic principles for implementation in Lahore's urban and healthcare setting, focusing specifically on examining current healing spaces and exploring potential for creating culturally appropriate, sustainable and healing healthcare spaces.

Conclusion of Review of Literature

The literature reviewed emphasized the significance of the Biophilic Design and Natural Integration approaches in the current concepts of healthcare architecture. Research shows that patients benefit from positive interactions with natural environments during recovery, that patients' emotional health is enhanced by natural environments, that staff's productivity is improved by natural environments, and that overall healthcare experiences are improved by a natural environment. The idea of therapeutic landscapes, healing gardens and the concept of a “Hospital in a Garden” demonstrates the transformation of the sterile clinical hospital environment into a space which is ecologically-sensitive and healing. International case studies also show that the implementation of biodiversity, green spaces and sensory-rich outdoor spaces is possible in dense urban health care facilities. Yet, when it comes to Lahore, there is considerable lack of research and application of biophilic design in healthcare. While it is common for existing hospitals to not make use of open spaces, it is also frequent to not plan therapeutic landscapes in the overall plan. Thus, this study is a must as it fills the gap between the international biophilic healthcare practices and local environmental, cultural and urban context of Lahore and ultimately adds to the development of more sustainable, humane and healing oriented hospital environment.

RESEARCH METHODOLOGY

The methodology that has been followed to assess the biophilic design and therapeutic impact of healthcare settings in Lahore is described below. The methodology aimed to systematically examine the relationship between open spaces in hospitals and the environmental design for healing using spatial, environmental and user-oriented assessment methods. The research approach prioritizes the investigation of courtyards, gardens, and healing environments as part of the healthcare built environment, highlighting their accessibility, environmental qualities, and importance for patient and staff health and wellbeing.

The study was of a mixed-method type using both elements of the qualitative site evaluation and quantitative spatial analysis, to get a holistic view of healthcare environments. This methodological blend facilitated the research in evaluating the physical presence of natural elements and how well they were integrated into the hospital context. The spatial experiences, environmental conditions, landscape quality and user interaction with outdoor spaces were analyzed through qualitative assessment methods, and the spatial organization, accessibility and environmental performance indicators were analyzed

using quantitative methods. A mixed-method approach improved the trustworthiness of the study as it enabled the quantitative data gathered from the spatial elements and the qualitative data from the experiential elements to be analyzed in a unified research design.

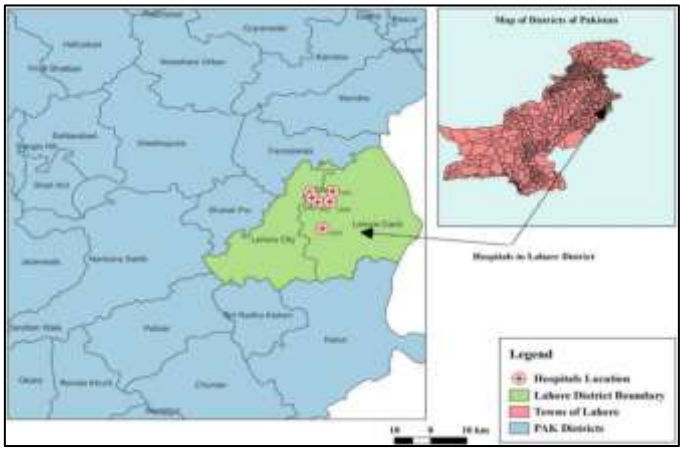

Figure 03 Location & Context of selected case studies (Lahore location, Indus Hospital, Doctor's Hospital, Ghurki Teaching Hospital, Central Park Teaching Hospital & Evercare Hospoital)

Lahore was chosen as the main study area because it is the biggest metropolitan city in Pakistan and it is one of the healthcare hubs of the region. The context of nature-integrated healthcare environments is significant for the rapidly evolving urban fabric, the growth in urban population density, and environmental issues in the city. The city of Lahore is subjected to extreme climatic conditions, especially in summer when the temperature is high and the heat island effect makes the environment uncomfortable in health care facilities. The above climatic facts call for the need of shaded courtyards, therapeutic gardens, and outdoor spaces that are sensitive to climate to enhance thermal comfort and psychological health. Also, the presence of colonial era hospitals and modern healthcare complexes in the city provides a rich architectural contrast to be analyzed.

The selection of hospitals was done using purposive sampling to ensure representation of a variety of architectural typologies, environmental conditions and space scales. The chosen hospitals ranged from historic to modern hospitals to compare planning approaches and landscape incorporation strategies. The criteria used to identify schools for selection were that they have historically been diverse, are at institutional scale, and have identifiable green or open spaces, including courtyards, gardens, or landscaped areas. A selection of hospitals with a high number of patients and visitors were chosen to increase the understanding of the interaction between healthcare users and outdoor environments. The presence of facilities with existing green spaces allowed the research to explore how effective and functional the spaces are as healing environments.

A variety of complementary data collection methods were employed in order to assess the selected health care facilities in a comprehensive way. Field observations and spatial analysis were used as a key part of the study, and detailed on-site investigations of movement patterns, accessibility, environmental quality and the relationship between indoor and outdoor spaces were carried out. Special focus was paid to the circulation network, seating arrangements, distribution of vegetation, shading conditions and the visual connections to nature. Photographic documentation was also used to systematically document the physical condition and characteristics of the healing spaces, such as the quality of the landscape, the maintenance of the space, the natural lighting, and the integration of the space into the natural environment. Informal interviews and questionnaires were discussed with

patients, visitors and hospital staff to find out their perception about comfort, accessibility, usability and psychological benefits of the outdoor spaces, whenever required.

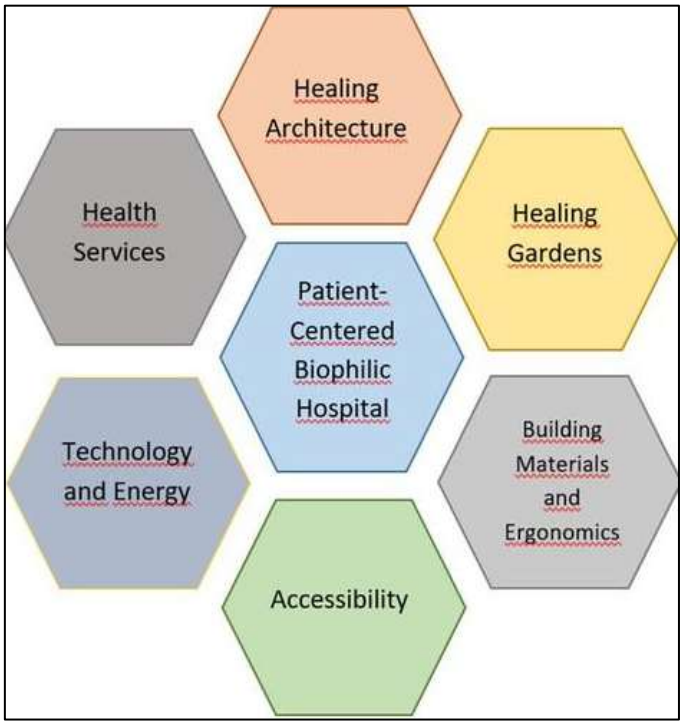

Figure 04 Overall aspects explored

The evaluation process was facilitated using a structured framework for the biophilic design audit, based on established principles of biophilic theory and research on healing environments. The audit centered around a number of environmental and spatial indicators including visual access to greenery, sensory experience of the interplay with the natural environment, thermal comfort, variation in airflow, accessibility, and environmental usability. Visual connection indicators were used to assess the degree to which patients and visitors could have access to natural views from the waiting areas, wards and circulation areas. A non-visual connection measured sensory elements like natural sound, scent and touch with plants and landscape elements. Thermal and airflow assessments were carried out to assess the performance of courtyards and open spaces for passive environmental comfort through the provision of shading and natural ventilation. The accessibility criteria also assessed the usability and ease of movement of healing spaces for people with different physical capacities.

Data collected were analysed using comparative spatial mapping techniques and descriptive analytical methods to determine the underlying patterns, strengths and weaknesses of the selected hospitals. Comparative analysis allowed the research to identify the differences in landscape quality, spatial integration, accessibility and environmental performance between public and private healthcare facilities. The findings were analysed in a systematic manner to look for successful design interventions and common inadequacies in planning and maintenance of healing space. This analytical approach has given a critical insight to the current state of biophilic principles being applied in healthcare settings in Lahore and has been the basis for recommendations of design and planning for the future to develop a more restorative and sustainable hospital setting.

DATA ANALYSIS & DISCUSSION

The results of the field-based bio-philic audit carried out in the selected hospitals in Lahore reflect the intricate linkages between hospital design, environmental conditions and the incorporation of therapeutic landscapes in hospital premises. The results show that there are many healthcare spaces with high spatial potential to create healing environments, but most of them are not used, are poorly managed,

or are isolated from the healthcare environment. The analysis also shows that institutional priorities, architectural typology, maintenance culture and environmental planning strategies have a strong impact on the quality and functioning of open spaces in the hospital. These findings concur with the underlying theories presented above and the need to integrate nature into the design of a healthcare environment to enhance psychological comfort, patients' recovery, and environmental sustainability.

These hospitals were a cross-section of Lahore's healthcare system ranging from colonial era public hospitals to modern private medical facilities and specialized long-term care centers. Typically the public-sector institutions like Mayo Hospital, Sir Ganga Ram Hospital, Services Hospital and Jinnah Hospital displayed traditional planning, which included open courtyards, large circulation spaces, and naturally ventilated spaces. These were the facilities which showed better spatial connectivity with their environment than many of the modern healthcare complexes. Private hospitals, however, like Evercare Hospital Lahore, Doctors Hospital & Medical Center, National Hospital & Medical Centre and Hamid Latif Hospital showed a more technologically advanced and vertically integrated approach to healthcare with smaller but more aesthetically refined and maintained green spaces. The contrast reflects the changing focus of health care architecture, as vertical expansion and increased efficiency take the place of an accessible and ecologically significant outdoor space in contemporary health care planning, at times even at their cost.

Figure 05 Cross comparison of Public VS Private Hospital analysis

The analysis of courtyards and gardens showed a significant difference between the planned use of these spaces and their physical state. Hard paving material (concrete, asphalt) usually prevailed in many of the outdoor spaces in both public and private hospitals, limiting their environmental and therapeutic value. Over the years, some courtyards in several public-sector hospitals had been transformed into parking spaces, storage areas, or circulation spaces, as the pressure of infrastructure and overcrowding had taken their toll. While there were trees in some locations, the lack of layered planting, biodiversity, shaded seating and sensory rich landscapes reduced the restorative quality of these environments. The lack of diversity in vegetation further decreased opportunities for sensory engagement and ecological interaction and consequently the ability of these spaces to be considered as a true therapeutic landscape. This discovery highlights a wider problem in the field of urban healthcare design that green spaces are not considered a primary element of urban healthcare but rather a secondary visual feature.

The biophilic design audit also identified the varying levels of connection between the indoor healthcare spaces and the natural environment outside. Older hospital wards, in particular the wards that were

developed in phases of colonial planning, showed greater visual connection with courtyards and gardens in the form of larger windows and open corridors and through the natural ventilation of the building. These design features inadvertently complemented modern biophilic principles of allowing daylight to enter, air circulation and sight lines of green space. On the other hand, many contemporary hospital structures showed low levels of visual connection to the natural surroundings with the characteristics of small floor plan size, sealed facades and controlled climate in the interior. Patients in newer facilities often did not have a direct view of greenery or an outdoor therapeutic area, making for very contained, but psychologically distant environments. Water features were lacking or poorly maintained in hospital landscapes, which further reduced the multi-sensory qualities of these places. The design of water elements, known internationally as a calming and restorative element in therapeutic landscapes, was often poorly maintained, lacked water supply or infrastructure issues.

It was also found that there was a lack of spatial complexity and sensory diversity in the hospital gardens and courtyards. Biophilic environments are usually multi-sensory, with tactile (texture), color, auditory (sounds), visual (light) and movement elements. But many of the validated spaces failed to provide the richness of the environment that is required to encourage psychological rejuvenation and emotional comfort. The lack of landscaping and paving repetition, seating and lack of shaded transitional areas limited the opportunities for extended use and social interaction. In some hospitals, the outdoor areas seemed to be isolated from the everyday life of hospitals and were not commonly included in patients' recovery programs or staff's relaxation time. This suggests that the healing landscapes in Lahore's hospitals are considered as "afterthoughts" in the aesthetics instead of as active therapeutic infrastructures that can help in achieving the healthcare outcomes.

Accessibility and maintenance proved to be key factors playing a pivotal role in the functionality and effectiveness of therapeutic landscapes in healthcare settings. Some hospitals had potentially valuable green spaces, but a lack of access to these areas was caused by physical barriers like locked gates, uneven pathways, steps and restricted circulation routes, which made it difficult for elderly patients, wheelchair users and people with reduced mobility to access the areas. These conditions can threaten the inclusive and restorative nature of healing spaces, especially in healthcare buildings, where everyone needs to be able to access and use these areas. A lack of maintenance exacerbates the problem. Inadequate irrigation, unmaintained landscaping, broken seats and trash disposal were aesthetically unappealing and psychologically stressful. Poorly maintained outdoor areas did not decrease anxiety and promote relaxation; in fact, they often made users feel even more anxious and disheartened about the neglect they felt was prevalent in institutions. Private hospitals, on the other hand, tended to have more robust maintenance regimes, regular landscaping practices and cleaner facilities, all of which had a positive impact on the overall impression of the quality of the health care and emotional wellbeing.

Comparative analysis of public and private hospitals points to significant differences in the environmental performance and spatial organisation of these institutions. The public-sector hospitals though experiencing severe maintenance and infrastructural challenges, showed a greater climatic responsiveness because of open courtyard and natural ventilation systems. Their generous spatial layouts provided for increased ventilation, illumination and space for the incorporation of larger therapeutic landscapes. But their potential was undermined through lack of maintenance and strategic environmental planning. However, private hospitals were seen to be more meticulously maintained, more aesthetically pleasing, and more strictly controlled in environmental conditions, but lacked spatial openness and meaningful ecological integration because of compact and vertical planning models. This contrast, however, is indicative of a crucial paradox of Lahore's health care settings: despite the better environmental bases for the public hospitals, their management systems are not as robust; while the management systems of private hospitals are, they often sacrifice ecological depth and spatial access.

Overall, the results show that in Lahore, the basic spatial structures are available in hospitals to apply biophilic design by utilising courtyards, gardens and open spaces. Yet, in these settings there are still

major gaps in functional planning, environmental integration, accessibility, and long-term maintenance, which are not meeting standards. The problem is not just allocation of space, but lack of strategic design interventions and institutional appreciation of the healing power of nature. The current study definitively concludes that existing hospital environments in Lahore can be improved to become a restorative healthcare space with low cost landscape, sensory-based design approaches and improved spatial connectivity for the healing of patients, well-being of staff and for ecological sustainability.

SUMMARY OF FINDINGS

The study emphasizes the importance of biophilic and nature integrated design in healthcare settings in Lahore and its potential applications that are largely untapped. The field audits in both public and private hospitals showed that while many hospitals had courtyards, gardens and open spaces, these spaces are often not used as therapeutic spaces. The hospitals showed relatively high climatic responsiveness as they were from public sector, had relatively larger open spaces, and layout was naturally ventilated, based on courtyard type planning system. But poor upkeep, poor landscape management, and lack of environmental planning had taken their toll and diminished significantly their restorative value. With the exception of the more clean and aesthetically neat landscapes and higher standards of maintenance that were generally found in private hospitals, their small-scale, vertically oriented architectural design more often than not meant that there was very little provision for human interaction with nature, and no provision for accessible spaces to connect with nature for healing. The study also found several common issues in all the facilities that were audited: too much hard paving, lack of diversity of plants, lack of shaded seating areas, lack of sensory stimulation, poor accessibility for users with mobility impairments, and no active water features. The results also revealed that a significant number of out-of-hospital areas were viewed as an accessory to the aesthetics of the interior of the buildings and not as part of the healthcare process or patient rehabilitation. Furthermore, the absence of a proper biophilic planning approach and the institution's lack of awareness of therapeutic landscapes affected the performance of these places. Even these challenges, the study has established that the hospitals in Lahore already have the spatial basis for adopting biophilic health care strategies. Creating healing environments in existing courtyards and gardens can be achieved with simple and affordable landscape enhancements, better management of the environment and better connection with the therapeutic outdoor space and the indoor healthcare space. In summary, the study highlights the importance of healthcare architecture in fostering mental health, environmental quality, and sustainable urban healthcare systems.

RESEARCH CONCLUSIONS

The study concludes that there is a significant potential of biophilic design to enhance the quality of healthcare environment in Lahore by making it more restorative, humane and environmental friendly. The results show that, apart from medical technologies and operational efficiency, the healing qualities of hospitals is also affected by the spatial, environmental and psychological experiences created by the built environment. Courtyards, gardens and open spaces are considered as important but largely unused resources in hospitals in Lahore which can play a significant role in patient recovery, stress reduction, staff health and satisfaction of the healthcare delivery system. The study also finds that the traditional courtyard based layout of hospitals, especially in older public sector hospitals, unwittingly incorporates several of the more recent biophilic principles, in terms of natural ventilation, daylight access and spatial openness. These landscape benefits are however not always maintained, landscape integration is not always strong and strategic planning is not always present. In the meantime, high-tech individual healthcare centers show an enhancement in the management of aesthetics and environment with very little ecological depth and connection to nature. The research consequently highlights the need to shift the therapeutic landscapes from being peripheral "ornamentation" to integral part of the healthcare infrastructure. The incorporation of biophilic aspects in the design of hospitals can help to create a more comfortable environment, reduce stress, and foster a more positive mindset in both patients and staff,

contributing to the overall healing process. Moreover, the study enhances the scarce literature available on biophilic healthcare design in the local context of Pakistan and will serve as a localized approach to assess the healing spaces in urban hospitals. In conclusion, the study highlights the vital need to develop healthcare settings that integrate clinical efficiency with ecological awareness, environmental sustainability, and human health, especially in rapidly urbanizing cities like Lahore.

RESEARCH FUTURE DIRECTIONS

The results of this study suggest several interesting avenues for future study and application in the field of healthcare architecture and urban environmental design. Future research should include quantitative and qualitative data on biophilic healthcare and patient recovery rates, psychological health, stress reduction and staff productivity, as well as additional medical evidence. Longitudinal studies that look at the long-term effects of therapeutic landscapes on health care outcomes would be more solid evidence for incorporating nature-based interventions into hospital planning policies. Further studies can also be conducted to study the correlation between climate responsive landscape design and thermal comfort in healthcare facilities in the context of growing heat stress in cities like Lahore. Comparative analysis with hospitals in other cities of Pakistan and other South Asian cities could also help in building a biophilic healthcare solution that is adaptable to the region. In practice, future design practices should focus on converting underused courtyards and the leftover open spaces into safe, accessible and multi-sensory therapy spaces. Greater consideration should also be focused on universal accessibility and integration of biodiversity, sensory landscaping and the use of water-sensitive design strategies within the hospital landscape. Future hospital development policies and standards should include biophilic planning guidelines and environmental performance metrics to promote better health. The integration of healing environments that address both human and ecological needs will require collaboration between architects, landscape designers, healthcare practitioners, and environmental psychologists and planners. In addition, in the future, digital simulation technologies, environmental monitoring systems, and participative design approaches can help to enhance the planning of healthcare systems in a more effective and user-centered manner.

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