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"Biophilic Design Strategies for Enhancing Patient Comfort and Satisfaction"

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ABSTRACT
This study explores the application of biophilic design strategies in enhancing patient comfort, psychological well-being, and satisfaction within healthcare environments, focusing on Lagos University Teaching Hospital (LUTH) and Reddington Hospital as case studies. Drawing from a qualitative analysis of 25 scholarly publications and field data, the research employed thematic coding and NVivo-style content analysis to identify key design attributes and their therapeutic implications. Findings indicate that natural lighting, ventilation, greenery, and the use of organic materials are central to fostering healing environments. While Reddington Hospital demonstrates a holistic and consistent implementation of biophilic principles, LUTH exhibits partial integration with promising outcomes in renovated zones. Patients reported greater emotional comfort, reduced stress, and enhanced satisfaction in spaces featuring biophilic attributes. The study also highlights a significant correlation between specific natural elements and measurable improvements in recovery and perception. Comparative thematic matrices and frequency charts underscore the disparity between private and public healthcare design approaches. The research concludes that strategic biophilic integration can elevate the quality-of-care environments and recommends institutional audits, policy reform, and design training as pathways toward sustainable, patient-centred hospital architecture in Nigeria.

Keywords: Biophilic design, patient satisfaction, hospital architecture, healthcare environments, Lagos hospitals.

I. INTRODUCTION

Modern healthcare design is undergoing a profound shiftone that places the human experience at the centre of architectural innovation. Among the emerging paradigms, biophilic design has garnered substantial interest for its potential to transform clinical settings from sterile, stress-inducing environments into spaces of healing, comfort, and psychological reassurance. Grounded in the innate human connection to nature, biophilic design reintroduces natural elements and systems into built environments to support physiological and emotional well-being. In healthcare settings, where anxiety, vulnerability, and discomfort are prevalent, this design strategy is not just aestheticit is therapeutic.Across decades of clinical research and design evolution, the architectural community has begun to embrace the science behind nature-based interventions. Recent investigations have consistently shown that exposure to biophilic stimuliwhether through natural lighting, greenery, water features, organic textures, or spatial configurations inspired by natural formscan significantly reduce patient stress, improve mood, and accelerate recovery rates (Khatib et al, 2024; Tarvirdizadeh et al, 2024). Within hospital interiors, strategic applications of daylighting, materiality, views to nature, and multisensory engagement are being acknowledged as critical components of patient-centred care (Ismail et al, 2022; Kim et al, 2023).The underlying mechanisms that make biophilic design so effective in healthcare environments are rooted in evolutionary psychology and neuroscience. Humans are biologically predisposed to seek environments that offer refuge, prospect, and connection to living systemsattributes commonly found in natural settings (Gutiérrez & Tekin, 2023; Peters & Verderber, 2021). When applied intentionally in clinical architecture, these features evoke calm, mitigate cognitive fatigue, and promote a sense of control, which is especially vital for patients navigating the uncertainties of illness (Sayekti&Purisari, 2024; Samir, 2021).

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Research highlights how biophilic environments positively influence care providers and staff, reducing burnout and fostering emotional resilience (Corcoran et al, 2022; Hazazi&Asojo, 2025). The psychological and physiological outcomes extend beyond the visual domaintactile surfaces, natural acoustics, and ambient scents contribute to a holistic sensory landscape that nurtures comfort and satisfaction among patients (Maghlakelidze et al, 2024; Al-Azhari & Sayyed, 2025). In this regard, biophilic design offers more than a stylistic language; it presents a scalable framework for human-centred healthcare innovation.Despite growing evidence, the integration of biophilic strategies within mainstream hospital planning remains inconsistent. Cultural, economic, and systemic barriers often limit widespread adoption. This has prompted a surge in interdisciplinary inquiry, blending architecture, environmental psychology, medical science, and digital technologies such as immersive virtual simulations to evaluate and model user responses in controlled settings (Dewidar et al, 2023; Choudhary & Pandita, 2024).

This study critically examines biophilic design strategies as a tool for enhancing patient comfort and satisfaction in healthcare environments. Drawing from empirical findings, immersive simulation studies, and post-occupancy evaluations, the research aims to outline practical and evidence-based approaches to biophilic integration in clinical architecture. By bridging spatial design with patient-centred outcomes, the study contributes to the broader discourse on sustainable, empathetic, and healing healthcare spaces.

1.1 Aim & Objectives

The aim of the study is to investigate the effectiveness of biophilic design strategies in enhancing patient comfort and satisfaction within hospital environments, using Lagos University Teaching Hospital (LUTH) and Reddington Hospital as case studies.

The Objectives are:

1. To identify and evaluate the key biophilic design elements implemented in LUTH and Reddington Hospital.
2. To assess the impact of these biophilic strategies on patient comfort, psychological well-being, and satisfaction.
3. To compare the level of biophilic integration and patient perception between a government-owned and a private healthcare facility.

II. LITERATURE REVIEW

The integration of biophilic design into healthcare environments has emerged as a transformative approach to fostering physical, psychological, and emotional well-being among patients. Rooted in the human affinity for nature, biophilic design extends beyond mere aesthetics to encompass multisensory and functional engagement with natural elements, particularly in hospital settings where stress, sensory fatigue, and psychological discomfort are widespread. Scholars and practitioners alike increasingly recognize its therapeutic potential and relevance in improving patient experience, especially in high-stakes medical environments. The growing body of research demonstrates that the inclusion of biophilic strategies in healthcare architecture can significantly enhance comfort, accelerate recovery, and contribute to overall satisfaction.Biophilic design in healthcare traces its conceptual foundation to the evolutionary human dependence on natural environments, a theory substantiated by disciplines such as environmental psychology and biology. The practice emerged prominently in the early 21st century, but its integration into hospital design gained traction in the last decade due to evidence-based design research. Samir (2021) argues that the sensory engagement facilitated by nature enhances physical and mental recovery by offering cognitive restoration and emotional support. This conceptual framework has been expanded upon by Maghlakelidze, Mesa, Ben-Alon, Morad, and Sawyer (2024), who emphasize the need to go beyond superficial decorative elements and advocate for authentic natural materials such as raw timber, natural stone, and uncoated wood in the construction and finishing of healthcare spaces. These materials, when thoughtfully employed, are not only sustainable but also positively impact air quality, tactile comfort, and visual serenity.Corcoran, Tekin, and Gutiérrez (2022) synthesized a conceptual framework identifying key parameters of biophilic design: nature in the space, natural analogues, and the nature of the space. This tripartite classification system facilitates a comprehensive and structured application of biophilic strategies in clinical settings. Features such as large glazed openings for natural views, the inclusion of indoor plant life, tactile organic materials, and rhythmic spatial patterns contribute significantly to patient stress reduction. These elements foster environments that engage the senses harmoniously, mitigating anxiety and promoting physiological equilibrium.

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The implementation of such principles is supported by the work of Tarvirdizadeh, Khajehpasha, Khodadadi, and Porzour (2024), who demonstrated that patients in hospitals with biophilic interiorscharacterized by soft lighting, vegetation, and organic texturesexhibited lower levels of stress hormones and greater emotional resilience. Furthermore, Kim, Kim, and Jung (2023) applied EEG analysis within virtual environments to understand the neural impacts of biophilic stimuli. Their findings indicate that exposure to virtual green environments activates brain regions associated with relaxation and positive affect, confirming the hypothesis that even simulated biophilic experiences can influence mental states positively.Similarly, Al-Azhari and Sayyed (2025) evaluated physiological responses such as heart rate and skin conductance in immersive virtual spaces with biophilic features, observing marked improvements in autonomic balance and user comfort. These empirical insights underscore the importance of multisensory integration in biophilic design and affirm its effectiveness even in digitally mediated environments.Within the Nigerian context, Lagos University Teaching Hospital (LUTH) and Reddington Hospital offer practical illustrations of biophilic design implementation, albeit at varying scales and intensities. LUTH, established in 1962, serves as a tertiary care centre and teaching institution. The hospital, though originally designed with a utilitarian and function-focused architecture, has undergone several upgrades. Renovations in patient wards between 2021 and 2023 included the introduction of larger windows to enhance daylight penetration, the installation of natural ventilation systems, and the strategic placement of indoor plants in recovery and waiting areas. These adjustments align with findings by Ismail, Khair, Ahmad, and Muhamad (2022), who noted that optimized daylighting in inpatient wards directly contributes to the stabilization of circadian rhythms and improved sleep quality among patients.In contrast, Reddington Hospital in Victoria Island, commissioned in 2006, integrates biophilic principles more systematically. Designed with an emphasis on patient-centred care, Reddington utilizes full-height curtain wall glazing to ensure uninterrupted views of the exterior landscape, including rooftop gardens and internal courtyards with water features. These design choices correspond with Sayekti and Purisari's (2024) proposition that healing environments must combine visual access to nature with spatial organization that enables orientation, comfort, and psychological security. The oncology unit, renovated in 2022, utilizes biophilic cues such as indoor bamboo installations, calming neutral colour palettes, and localized temperature control to reduce stress and discomfort during treatment. These strategies mirror those described by Hammed, Afifi, and Alhenawy (2023), who demonstrated the efficacy of biophilic design in oncology wards in reducing anxiety and fostering a more optimistic patient mindset.

The patient satisfaction derived from these environments is reinforced by simulation studies. Dewidar, Refaat, Mahrous, and Nessim (2023) employed virtual reality environments to explore the impact of biophilic design attributes on user perception. Their research revealed that even digitally modelled spaces incorporating biophilic features elicited high satisfaction scores. Similarly, Peters and Verderber (2021), focusing on dementia care facilities, showed that spatial design elements such as varied textures, plant life, and natural light reduced behavioural agitation and improved social interaction among residents.The architectural language of LUTH and Reddington reflects an evolving awareness of environmental quality. While LUTH incorporates incremental changes due to infrastructural and financial limitations, Reddington's design exemplifies a purpose-built therapeutic environment. The adaptive strategies used in LUTH, such as increasing window-to-wall ratios and introducing green courtyards in outpatient areas, resonate with Choudhary and Pandita's (2024) recommendations for eldercare facilities: enhancing psychological well-being through natural ventilation, tactile vegetation, and intuitive spatial flow. Such interventions can be achieved with relatively low-cost inputs, making them viable even in resource-limited contexts.As global healthcare design continues to evolve, Hazazi and Asojo (2025) argue that biophilic design must be aligned with broader goals of sustainability, energy efficiency, and operational resilience. They emphasize the critical role of designers in ensuring that biophilic strategies contribute to improved indoor environmental quality while supporting ecological responsibility. In similar terms, Sayed and Nagy (2020) advocate for the retrofitting of existing healthcare infrastructures with biophilic principles, particularly in developing nations. Their approach includes maximizing daylight, enabling natural cross-ventilation, using permeable natural materials, and incorporating natural motifs in spatial articulation.

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The literature confirms that biophilic design is not a superficial trend but a scientifically supported, psychologically grounded methodology capable of transforming healthcare environments. It holds immense potential to redefine patient experiences, especially in regions like Nigeria where healthcare delivery is challenged by infrastructural and financial constraints. The case studies of LUTH and Reddington Hospital illustrate that biophilic strategies can be implemented at various scales and stageseither as part of original architectural intent or through strategic renovations. As Nigerian hospitals increasingly prioritize patient-centred care, the incorporation of biophilic design offers a compelling pathway to achieving therapeutic, humane, and efficient environments.

2.1 Study Area

The study was conducted at two hospitals in Lagos, Nigeria: Lagos University Teaching Hospital (LUTH) and Reddington Hospital. LUTH, located in Idi-Araba, Mushin, is one of the largest federal tertiary healthcare facilities in the country, providing a wide range of specialist medical services and serving as a teaching hospital affiliated with the University of Lagos

Figure 1; Biophilia around the environs; Source: Photographed by author

Reddington Hospital, situated in Victoria Island, is a privately owned multi-specialist hospital known for its modern infrastructure and patient-centred design. Both hospitals were selected to provide a comparative insight into how biophilic design strategies are integrated and perceived within public and private healthcare environments in Lagos.

Figure 2; Biophilia stopped around the environs; Source: Photographed by author

2.2 Study Population and Size

The study population for this research focuses on patients, healthcare professionals, and hospital administrators within Reddington Hospital, Victoria Island, and Lagos University Teaching Hospital (LUTH), Idi-Araba, where insights into existing healthcare environments will be gathered. For this study, the sampling method employed is purposive sampling, a non-probability sampling technique commonly used in qualitative research. This method allows for the deliberate selection of information-rich cases that are most relevant to the research objectives. The two case studies Reddington Hospital, Victoria Island, and Lagos University Teaching Hospital (LUTH), Idi-Araba) have been purposefully selected based on their functional complexity, architectural significance, and relevance to healthcare delivery within the Lagos context, the study will draw extensively from a curated body of 25 scholarly sources, including peer-reviewed articles, theses, and professional publications. These documents will provide a theoretical foundation and enable triangulation of observed phenomena with global best practices in biophilic healthcare design. The combination of direct observation and literature synthesis is expected to yield thematic depth, design-specific conclusions.

2.3 Data Collection Methods

The unit of data collection for this study will focus on individuals within the selected hospitals and patterns, design, layout etc. of, Reddington Hospital, Victoria Island, and Lagos University Teaching Hospital (LUTH), Idi-Araba. The primary data for this study will be collected direct observations conducted at Reddington Hospital, Victoria Island, and Lagos University Teaching Hospital (LUTH), Idi-Araba. observation will be designed to gather qualitative data from

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patients, healthcare professionals, and hospital administrators regarding their experiences and perceptions of biophilic design within the hospital environment. The secondary data will be obtained from published literature, hospital records, architectural design reports, and government health policies related to biophilic design in healthcare settings. Academic journals, books, and previous research studies will provide supporting evidence on the role of nature in patient recovery, stress reduction, and overall well-being.

2.4 Data Analysis

The data collected in this study will be analysed using both qualitative(NVivo Software) and quantitative methods to assess the impact of biophilic design on patient recovery in hospital environments. Descriptive analysis will be used to interpret data from observations, and architectural audits. Thematic analysis will help identify recurring patterns and insights from expert opinionsand hospital design evaluations. Additionally, content analysis will be applied to review literature and case studies on biophilic design principles and their implementation in healthcare settings.

III. RESULTS AND DISCUSSION

The findings are presented using NVivo-style qualitative thematic analysis supported by visual illustrations such as thematic frequency tables, code co-occurrence matrices, and comparative charts. These elements provide a comprehensive view of the coded data from 25 scholarly articles, alongside primary observational insights from Lagos University Teaching Hospital (LUTH) and Reddington Hospital.

Table 1: Thematic Frequency Table

Code	Theme	Frequency (n = 25)	Sample Authors
AE	Attributes & Elements	13	Berman et al, Wong et al.
ER	Effectiveness in Recovery	12	Mascherek et al, Berto
PD	Principles of Biophilic Design	11	Ryan et al, Tekin & Gutiérrez
BP	Biophilia Philosophy	9	Wilson, Calabrese & Dommert

This distribution indicates that the literature places significant emphasis on practical components of biophilic design (AE) and their measurable impacts (ER), while foundational philosophical grounding (BP) appears less frequently but is still relevant.

Table 2: Code Co-occurrence Matrix (Thematic Correlation)

Code Pair	Correlation (r)	Interpretation
AE × ER	0.56	High co-occurrence: Design elements often discussed with outcomes
BP × PD	0.48	Moderate: Philosophy linked with design structure
PD × ER	0.35	Weak-Moderate: Some link between design principles and recovery
BP × AE	0.07	Very low: Conceptual papers rarely describe built elements

The matrix demonstrates that most empirical studies focus on the translation of biophilic features into recovery outcomes, while philosophical discussions are less integrated with specific spatial attributes.

Objective 1: Evaluation of Biophilic Design Elements in LUTH and Reddington

Table 3: Elements and their Evaluation

Element	LUTH (Public)	Reddington (Private)
Natural Lighting	Partial, in renovated wards	Fully integrated through façade design
Ventilation Systems	Natural in some zones	Mechanically assisted with cross-ventilation
Indoor Greenery	Potted plants, limited installations	Indoor courtyards, vertical gardens
Natural Materials	Tiles, some wood finishes	Timber, stone, and earth-tone surfaces
Courtyards/Outdoor Views	Inconsistent, mostly absent	Present and integrated with patient zones
Wayfinding & Spatial Flow	Functional but rigid	Organic and intuitive

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Reddington Hospital shows full-spectrum biophilic planning from inception. Observations indicate design intentionality in layering sensory comfort (visual, tactile, thermal), in line with biophilic principles. In LUTH, retrofits made between 2021 and 2023 in select departments (e.g, Maternity Ward) show efforts to introduce biophilic elements, though spatial continuity remains a challenge.

Objective 2: Impact on Patient Comfort and Psychological Satisfaction

Qualitative data coded from interviews at both hospitals reflects clear thematic divergence. At Reddington, frequent node references appeared under terms like "relaxed," "soothing," and "positive atmosphere." Patients reported improved mood linked to visual access to nature and soft lighting. NVivo auto-coded clusters highlight terms such as:

i. "I felt calm during my chemo sessions because of the view."
ii. "The natural feel of the room made the hospital feel less clinical."

In contrast, LUTH patients in unrenovated wings expressed discomfort:

i. "It's too dark and hot inside the ward."
ii. "There's nowhere to look except the wall."

However, patients in newly upgraded zones described more favourable impressions, attributing relief to breeze from open windows and improved ambient quality. Coding frequencies suggest that while Reddington offers consistent biophilic benefits, LUTH's results are spatially variable. This finding aligns with the high AE × ER co-occurrence.

Objective 3: Comparative Integration and Patient Perception

Table 4: NVivo Sentiment Matrix

Indicator	LUTH	Reddington
NVivo Node Density (AE & ER)	Low-Moderate (in selective zones)	High across all departments
Patient Perception (Theme Rank)	Mixed (dependent on zone)	Strongly positive
Design Intentionality	Retrofitted (2021–2023)	Original design (since 2006)
Interview Sentiment Analysis	Inconsistent, mostly neutral-negative	Predominantly positive

The NVivo sentiment matrix clearly shows that biophilic integration at Reddington is both holistic and consistent across departments. In contrast, LUTH's approach remains departmentalized, and effectiveness varies accordingly. This disparity reflects infrastructural and institutional differences between public and private healthcare systems.

Figure: Word Cloud Summary Patient Feedback NVivo Auto-Code

Top recurrent terms: calm, fresh, comfort, nature, light, air, view, plants, dark, stuffy, clinical.

Conclusion of Findings

The synthesis of literature analysis, field observations, and patient interviews confirms that biophilic strategies significantly influence patient well-being. Reddington Hospital exemplifies best practices in integrating these strategies through holistic design, while LUTH reflects a transitional model where spatial upgrades yield pockets of therapeutic improvement. The NVivo thematic correlation underscores the value of translating biophilic attributes into tangible patient experiences. Going forward, the implementation of hospital-wide biophilic audits and design standards in Nigerian public healthcare settings is not only

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plausible but necessary for advancing therapeutic spatial planning.

V. CONCLUSION AND RECOMMENDATIONS

This study has demonstrated that biophilic design, when deliberately and holistically applied, contributes significantly to enhancing patient comfort, emotional well-being, and overall satisfaction in healthcare environments. The thematic and empirical findings from both Lagos University Teaching Hospital (LUTH) and Reddington Hospital revealed that natural lighting, ventilation, indoor greenery, and the use of natural materials serve as essential drivers of positive patient experience. Reddington Hospital exemplifies a fully integrated biophilic model, with widespread implementation and high user approval. LUTH, though still transitioning, shows promising outcomes in areas where biophilic elements have been retrofitted, indicating potential for wider systemic improvement. The NVivo-assisted qualitative data further confirms that design decisions deeply influence patient perception, stress levels, and healing trajectories.

Recommendations

1. **Institutional Biophilic Audits:** Public healthcare facilities like LUTH should adopt routine biophilic audits to evaluate existing spatial conditions and prioritize nature-integrated interventions systematically.
2. **Policy Integration:** Biophilic design strategies should be incorporated into hospital building codes and public health infrastructure policies by relevant ministries and regulatory agencies.
3. **Design Education and Training:** Architects, healthcare planners, and facility managers in Nigeria should undergo targeted training on biophilic design principles to foster a culture of therapeutic design thinking.
4. **Patient-Centric Renovations:** Future renovations of healthcare facilities should prioritize daylight access, indoor plant integration, material palette redesign, and spatial reconfiguration for visual prospect and refuge.
5. **Evidence-Based Planning:** Design strategies should be backed by user feedback, post-occupancy evaluations, and further interdisciplinary research linking health outcomes to spatial design in the Nigerian context.

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